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SCIENTIFIC AMERICAN

A Weekly Review of Progress in

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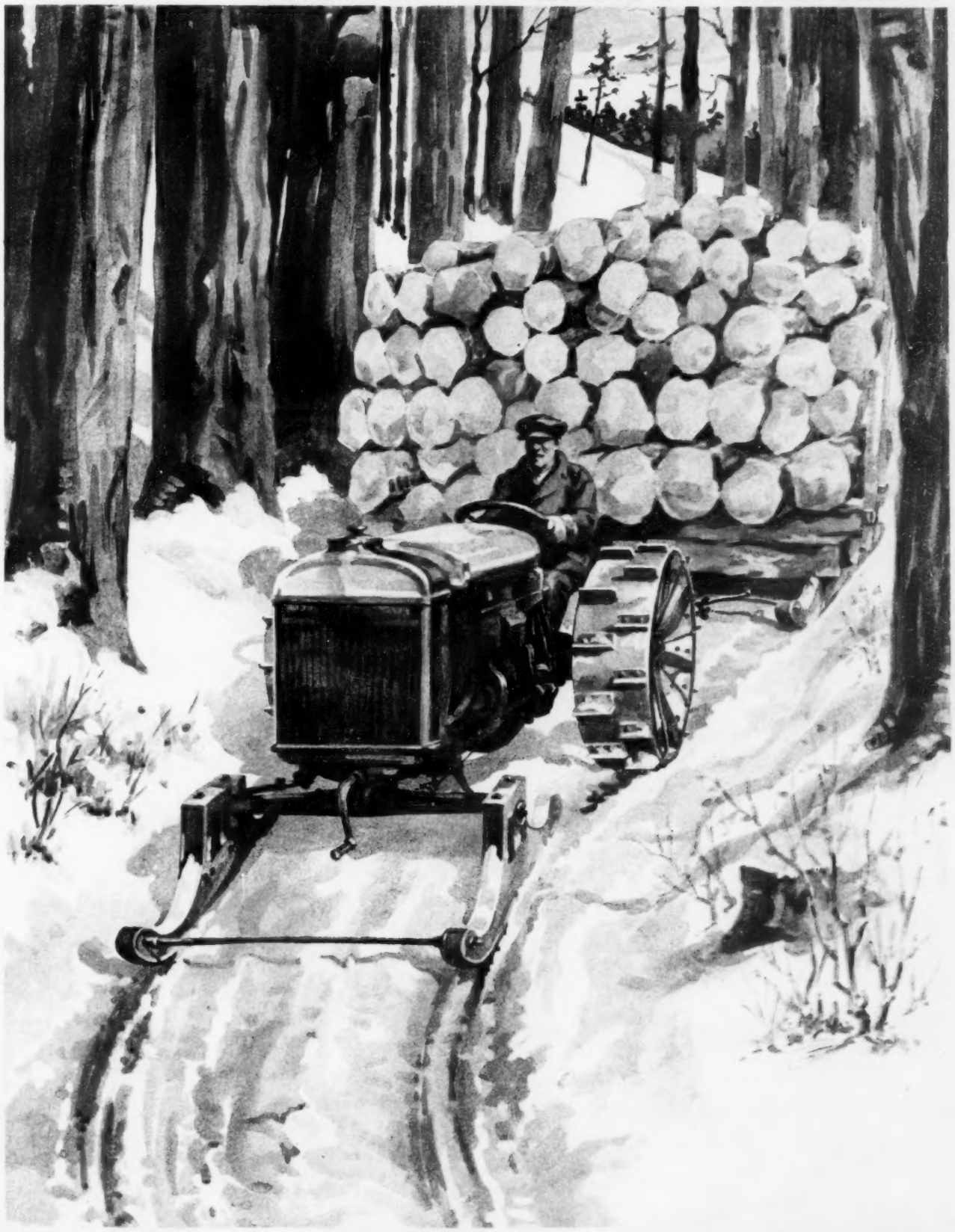

HAULING LOGS WITH A WINTER VERSION OF THE SMALL GASOLINE TRACTOR

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January 10, 1920

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FOR

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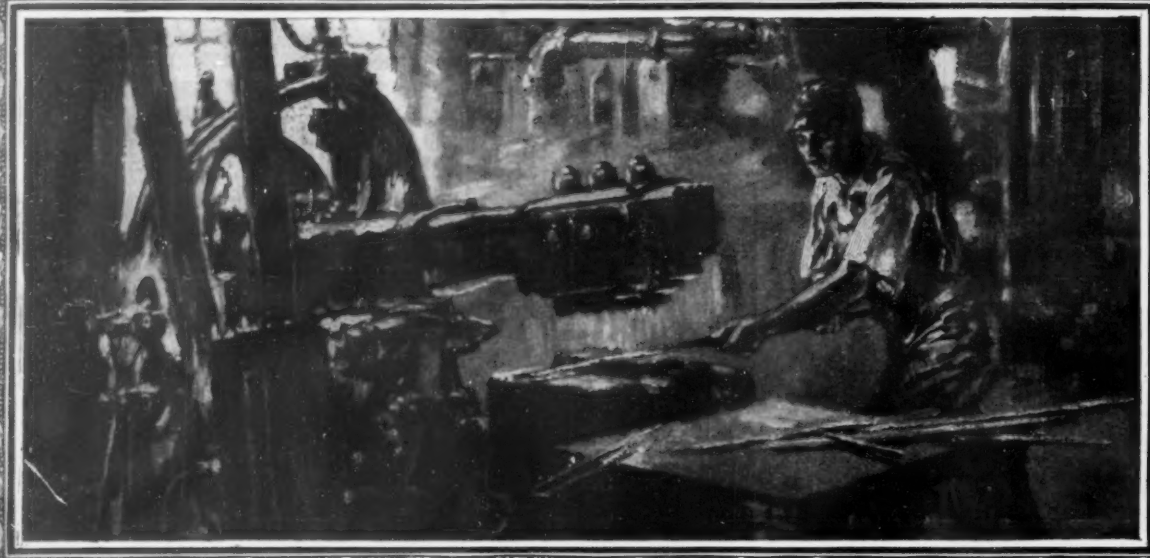

FOUR mighty blows to the second, but each one so nicely timed and delivered that it shapes as by magic the red hot bar in his skilled fingers. Here is all the craft of the ancient blacksmith, with the speed and economy of modern science. Here are all the ideals of half a century of success, that the Forgings, Tools, and Machines of the First Commercial Drop Forging Plant in America may still stand preeminent.

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SEVENTY-SIXTH YEAR

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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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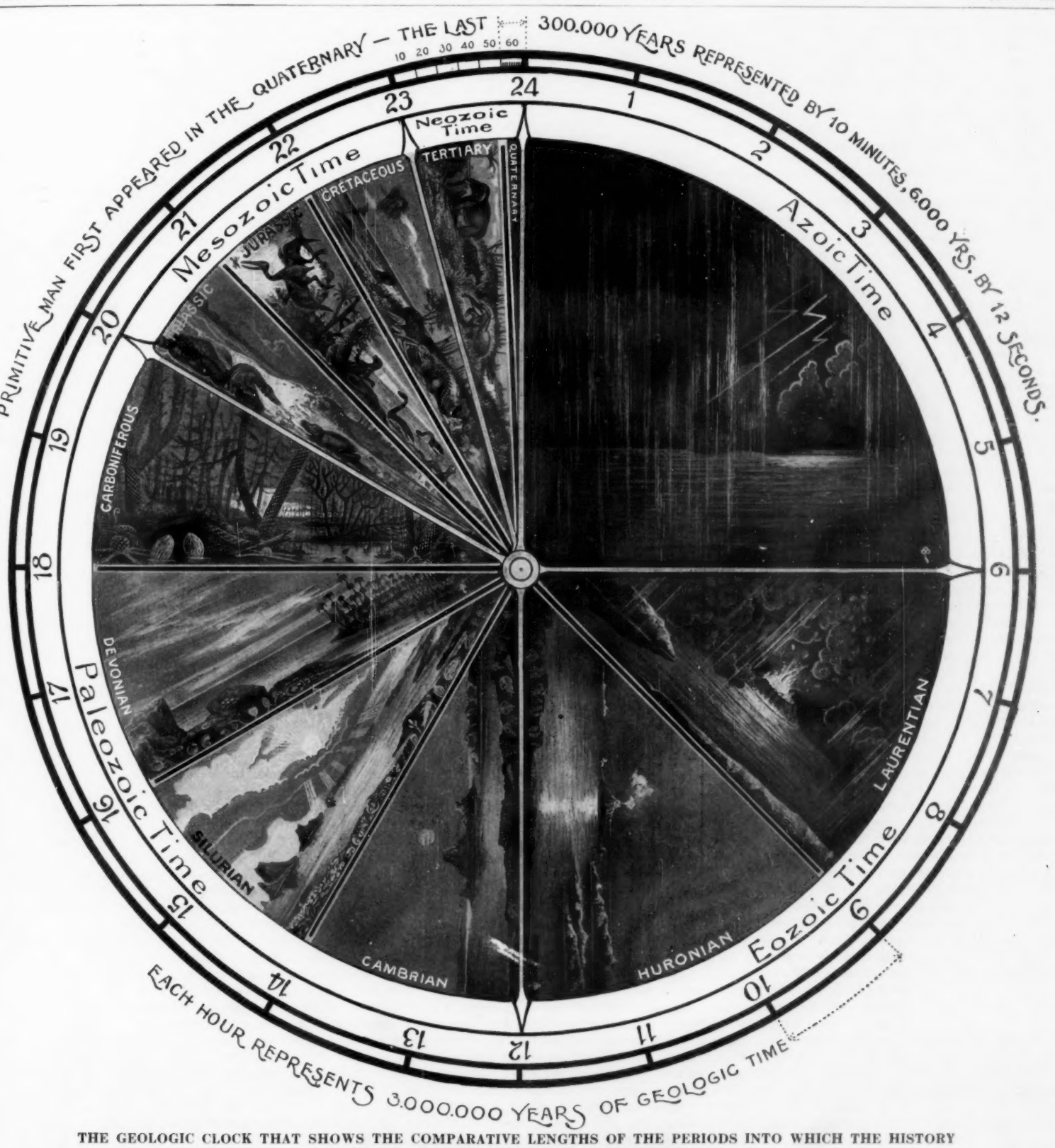
PRIMITIVE MAN FIRST APPEARED IN THE QUATERNARY — THE LAST 300,000 YEARS REPRESENTED BY 10 MINUTES, 6,000 YRS. BY 12 SECONDS.
10 20 30 40 50 60
Neozoic Time
TERTIARY
QUATERNARY
Mesozoic Time
CRETACEOUS
JURASSIC
TRIASSIC
Azoic Time
Paleozoic Time
CARBONIFEROUS
DEVONIAN
SILURIAN
CAMBRIAN
Eozoic Time
HURONIAN
LAURENTIAN
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
EACH HOUR REPRESENTS 3,000,000 YEARS OF GEOLOGIC TIME

THE GEOLOGIC CLOCK THAT SHOWS THE COMPARATIVE LENGTHS OF THE PERIODS INTO WHICH THE HISTORY OF THE EARTH'S CRUST FALLS—[See page 37]

Only in the Quaternary, which is to the whole as ten minutes to an entire day, has man existed; while the age of written history is confined to the last twelve seconds

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Scientific American Monthly

FORTY-THREE years ago the SCIENTIFIC AMERICAN SUPPLEMENT made its first bow to the public. It was a momentous year in the history of our country—the one hundredth anniversary of the founding of the Republic. We had fully recovered from the Civil War and we were opening a large international Centennial Exposition to show the world what progress we had made in the arts and sciences. As a result, there was great public interest in all scientific and technological developments, and it was felt that the time was ripe for a journal which would supplement the SCIENTIFIC AMERICAN by publishing articles of a more technical and special nature.

Today we are experiencing another revival of interest in science. The war has taught us what wonders science can perform when properly applied, and the public has been wakened to the importance of scientific research in our industries. It is to maintain and foster this interest that the SUPPLEMENT now gives way to the SCIENTIFIC AMERICAN MONTHLY—a journal expanded in size and scope.

The contents of the first number are full of interest. "How Do Men Walk With Artificial Legs?" The question is answered by Professor E. R. du-Bois Reymond, who has made a very interesting study of the difference between the natural gait and that of the cripple. He has attached Geissler tubes lengthwise to the legs of a man and photographed the pulsating light in the tubes while the man moved before the camera in a darkened room, thus obtaining a series of motion pictures upon a single plate. As a result of these experiments, he has arrived at certain conclusions which will have a bearing upon the design of artificial limbs. "Aerial Submarines" is the title of another interesting article in which Dr. Guglielmimetti, the celebrated physiologist, discusses the probability that the future airplane and airship will be fitted with chambers for passengers in which the pressure of the air will be maintained at normal. The "Mystery of Cold Light" is discussed by Dr. Raphael Dubois, Professor of General Physiology at the University of Lyons. He tells of his interesting experiments with luminous living creatures, and describes his "living lamp" which sheds a light produced by photobacteria.

Among the more practical articles is one on the method of anticipating thunder storms and atmospheric darkness at electric light stations. In order to prepare for such emergencies a wireless storm detector is employed which announces the threatened change in atmospheric conditions by the ringing of a bell. The U. S. Forest Products Laboratory has been making some interesting experiments on the automatic regulation of temperature and humidity in factories. The laboratory has designed conditioning devices by which the temperature and humidity in the factories may be automatically held at any desired values. "The Hvid Engine and Its Relation to the Fuel Problem" is an interesting paper describing a prime mover which in some respects resembles the Diesel engine, but which can be made in small units for service on farms and which will operate on crude oils and the cheaper grades of kerosene.

One of the objects of the SCIENTIFIC AMERICAN MONTHLY *is to supplement* as far as possible the SCIENTIFIC AMERICAN, giving further information on many topics which can be referred to only in brief in the SCIENTIFIC AMERICAN. Thus an article on the "Death of a Big Gun" supplements the article on "Why Big Guns Are Short-Lived," which appears in the current issue of the SCIENTIFIC AMERICAN; while the "Gearless Electric Locomotive" supplements the story of the "Tug of War" between an electric locomotive and two steam locomotives, which was published in the SCIENTIFIC AMERICAN a few weeks ago.

An important feature of the new journal consists in the summaries of current technical literature. These are classified under the heads of Mechanical Engineering, Electrical Engineering, Mining and Metallurgy, and Chemistry. The summaries in the department of Mechanical Engineering have been prepared under the auspices of the American Society of Mechanical Engineers, and those in the Department of Mining and Metallurgy under the auspices of the American Institute of Mining and Metallurgical Engineers. A section of the journal is being edited by the National Research Council, and there is a department prepared by the U. S. Bureau of Standards.

We have by no means given a complete list of the contents of the January issue. It contains ninety-six pages of interesting reading matter.

Obsolete at the Very Outset

THE Administration of this city is to be congratulated on its proposal to build twelve large terminal piers in one group at Staten Island; but it is to be condemned for building these piers upon plans that are out of date and that will greatly curtail their usefulness. So inadequate are the plans that they have evoked a chorus of condemnation from engineers, shipping men, handlers of freight and all the great commercial interests of New York. There are many things which are wrong about the design of these piers, but the whole truth in a nutshell is that while they would have been serviceable piers a quarter of a century ago, when labor was plentiful and cheap, they will be utterly out of date in these days of costly labor and highly economical labor-saving machinery.

In the era of the 200 to 300-foot clipper ship, carrying from 1,800 to 3,000 tons of cargo, piers of moderate length and width were sufficient to accommodate cargoes that had to be taken out, laboriously, by hand-operated whips or winches on the ship, or steam driven winches on the pier. With the advent of the steamship and the termendous growth in size of cargo ships, New York City, unfortunately, failed to make adequate provision to meet the larger cargoes that had to be handled and handled with speed, if serious congestion was not to follow. Always both the port and the cargo-handling facilities have been behind the times, and the present City Administration is working true to tradition in the matter of these new piers.

There are several up-to-date elements of the best freight-handling practice that cannot be used at the proposed Staten Island docks, first, because the piers are too narrow and therefore have not sufficient handling space, and, second, because they are too weak, both in the flooring and in the overhead construction, to accommodate the weights involved. Thus, they cannot use travelling cranes of the type installed at the Erie Terminal in Hoboken. They cannot, for want of space, accommodate floating cranes of the kind which are used in the Government service and can lift and swing 150 tons at one loading. They cannot utilize industrial tracks and trailers of the kind that are to be found at the Army Supply Base in Brooklyn, at the Bush Terminal Piers and at those of the New York Central and Pennsylvania Railroads. They cannot utilize, for want of space, or strength in the roof structures, the various conveyors, hoists, overhead tracks and other labor-saving devices which are to be found in other first-class ports of Europe and America.

It appears that out of the twelve new Staten Island piers only two, which are to be leased by the Pan-American Terminal and Dock Company, will be of the modern type. They will be two-storied structures with gantry cranes and abundance of space outside of the sheds on the first and second stories. Tracks will extend alongside the sheds for the accommodation of freight cars. But the other ten piers have the old-fashioned, comparatively narrow, one-story sheds, of the kind that did duty in the time of the sailing ship and when the steamship was only an experiment.

We have seen the excellent equipment at the leading European ports and at up-to-date piers in America such as those we have mentioned above. The essential features of a pier are sufficient width to allow of a wide, two-story shed in the center and of space on either side of the shed wide enough for two or even three parallel railroad tracks with hydraulic, electric or steam cranes running on the outer tracks adjacent to the steamships. The piers as at present designed for Staten Island, or at least all but two of them, make no provision for such a plant and equipment as this. They are simply an enlarged repetition of the terribly congested and quite inadequate piers with which the greater part of our water front is served today.

An Ordnance Department of Experts

ONE great lesson of the war is that preparedness involves, in addition to trained men, vast munitions and a productive industry capable of turning out these munitions. As Assistant Secretary of War Crowell has stated, "The war taught us that America can organize, train and transport troops of a superior sort at a rate which leaves far behind any program for the manufacture of munitions. It upsets the previous opinion that adequate military preparedness is largely a question of trained man power." We ought carefully to consider the question of munitions with regard to any future emergency, and at least adopt the most workable system and plans based on our late experience. In the United States the supply of munitions is entrusted to the Army Ordnance Department, and this corps, comprising but some 97 officers at the outbreak of hostility, was able to develop a munitions program and secure quantity production largely through bringing to its ranks some 5,000 emergency officers, made up of qualified technical men, manufacturers, and business men. Those responsible for this production are now a unit agreed that the only hope of coping with the question of adequate munitions, for any future emergency is by the complete coöperation of the army with mobilized industry. They realize that the manufacture of ordnance is not solely dependent upon its design by an ordnance expert, but involves many and complicated problems in production, in which not only military administration but industrial organization and equipment and most of all a trained personnel at all stages are concerned. Accordingly they are convinced that in ordnance, as in other work of production, there must be specialists in design and construction as well as in test and improvement, and these men must specialize not only in the general field of ordnance but in most cases in some single branch to which they devote themselves, with due concern, however, to the munitions program as a whole. Therefore it is not strange that the present General Staff Bill for the reorganization of the Army (S. 2715), which provides that the Army Ordnance Department shall be reduced to 51 trained officers, with the balance of its necessary quota supplied by detail for a period not to exceed four years and only after two years' line service, should be opposed by Major General C. C. Williams, Chief of Ordnance, and by the regular and emergency officers, as well as by the engineers and manufacturers who so patriotically and efficiently coöperated during the war, and who today, for further assistance to the country in this department, are united in a large and flourishing Army Ordnance Association. These men realize that only by a group of army experts continuously and constantly working on ordannce problems, and continuously and constantly in touch and coöperating with American industry, can a munition supply or a system for its prompt development be assured.

Electricity

General Utility Motors.—Several electric motor manufacturers have recently introduced what they term "utility motors." These devices are nothing more than electric motors mounted on portable stands, and provided with several pulleys working at different speeds so as to supply power for a wide range of work. About the small shop, on the farm, in the ultra-modern home, and elsewhere, the general utility motor offers an excellent source of power for many jobs.

A Novelty in Attachment Plugs.—A swivel attachment plug that is completely assembled when shipped and need not be taken apart to wire, and in which there are no screws, has been put on the market by an American manufacturer. It consists of an inner and an outer member revolving on each other. The wires are connected to the inner member, while the outer members comprise the ordinary screw shell and a knurled head made of heat-proof molded insulation. In wiring the new plug two wires are stripped about ⅜ inch and one is pushed into a center opening of the inner member and the other through any one of four concentric openings. By means of a soldering iron one wire is then sweated in the center opening, while the other, after being turned over into a groove on the inner member, is soldered thereto.

Baking by Electricity.—The extraordinary rise in the prices of fuel caused by the war has considerably furthered baking by electricity, although a great many electric bake ovens existed in Norway, Sweden and Switzerland before the outbreak of hostilities. The cheapness of coal at that time was not conducive to the bakeries taking up electric baking, in spite of the fact that in those countries which possess water power, baking by electricity is of considerable economic importance, as the employment of electric ovens permits the utilization of superfluous electric energy which usually cannot be made use of during the night. The night energy can be supplied by hydroelectric ponwer stations at such cheap rates as to make the use of electric ovens much more economical than those heated by coal or steam.

Electrical Heaters for Gasoline Distillation.—The *Electrical World* mentions a simple form of electric heater now being adopted in the United States for the distillation of gasoline and other volatile liquids, the boiling points of which it is desired to determine. The spiral heating coil of special resistance wire is inserted in a conical groove turned in a solid block of refractory insulating material and so arranged that practically all the heat is focussed upon a small opening 1¼ inch in diameter in the top of the device. The flask placed above the heater is thus subjected to sufficient heat without the danger of igniting inflammable vapor. The heater can be clamped to any convenient support and is provided with an adjustable rheostat. While primarily intended for the use indicated, it is thought that the concentrated heat which the device affords would be suitable in many cases in which a small gas flame is commonly employed.

Marconi Timed-Spark Continuous-Wave Transmitter.—The generation of continuous oscillations such as are now extensively used for radio-telegraphic signaling is commonly produced by the high-frequency alternator, arc systems such as the Poulsen arc, the three-electrode valve scheme, and, in addition, spark methods, one of which is known as the Marconi system. The production of a continuous wave from a damped spark discharge has been brought about by the introduction of multi-phase spark apparatus in which several quenched or rotary spark gaps were employed, each working on a separate phase of the supply circuit but feeding on a common aerial circuit. In this manner, continues *Wirelcss World*, the frequency of the discharges of each individual spark gap is reduced in proportion to the number of phases, although the resultant effective high-discharge frequency is maintained. By reducing the number of discharges to an exact sub-multiple of the oscillation frequency, it is possible to secure a fresh energy impulse to the aerial circuit once in every two, three or more oscillations instead of once in every one. The wave radiated will not then be quite undamped but will still be continuous, although the amplitude will be waxing and waning slightly between successive spark discharges.

Science

A New Popular Scientific Journal, to be known as *Discovery*, will be launched in England in January, 1920, under the ægis of the leading British scientific and educational organizations. It is to be edited by Capt. A. S. Russell, lately appointed reader in chemistry at Christ Church, Oxford. The new journal will aim to present, in brief monthly form, the progress of knowledge in all its chief branches. The project of establishing a similar authoritative journal in the United States, under the auspices of the American Association and the National Academy of Sciences, has been agitated for the past two years, and will, it is hoped, soon come to fruition.

International Medical Work.—The League of Red Cross Societies, which was organized last May, with headquarters in Geneva, now includes in its membership the national Red Cross societies of 26 countries. The offices of the League in Geneva have been opened, a staff of officials has been appointed, and a *Bulletin* is being issued. The director-general is Lieut.-General Sir David Henderson; secretary-general, Prof. W. E. Rappard; treasurer-general, M. André Pallain; general medical director, Col. R. P. Strong. The department of child welfare is headed by Dr. Leonard Findley, while Prof. Rocco Santoliquido is counsellor in international public health. There are numerous bureaux devoted to special topics. At the request of the Polish Government the League recently sent an Inter-Allied Medical Commission to investigate the pandemic of typhus fever in Poland.

Composition of Volcanic Gases.—A recent brief paper by Mr. E. S. Shepherd, of the Carnegie Geophysical Laboratory, presents preliminary results of the analysis of gases collected from the lava lake of Kilauea and calls attention to the important work of this character now in progress there under the direction of Dr. Jaggar. The matter ejected from a volcano is of special interest as tending to throw light upon the sources of volcanic energy. Abundant information has been collected concerning the composition of lavas, but little concerning the gaseous emanations of volcanoes. The difficulties of collecting such gases are naturally very great. Of the three attempts at such collections made by expeditions of the Geophysical Laboratory at Kilauea, only that of 1917 yielded samples satisfactory for quantitative study. In that case vacuum tubes with a soft glass plug at one end were wired to bamboo rods and the fusible end was inserted into promising flame holes as the lava crusts swept along the edge of the lake. Dr. Jaggar, who is permanently in residence at the Hawaiian Volcano Observatory, is now collecting gas samples systematically, and Mr. Shepherd believes that these samples "will give us for the first time the data needed to establish definitely the relative importance of the various suspected sources of volcanic energy."

Health Statistics and the Draft.—The results of the physical examination of the first million draft recruits, as set forth in a bulletin issued by the Surgeon General of the Army, provide a wealth of information heretofore unavailable concerning the distribution of physical defects and diseases in this country, as influenced, for example, by urban and rural life, by density of population, geographical location, etc. Thus it is inferred from these data that hernia, actual or incipient, is more influenced by the urban factor than by any other. Defects of vision are more common, by 30 per cent, among city dwellers than in the rural population. Otitis media is about 60 per cent more common in the cities than in the country. Flat foot (found in nearly one-fifth of the men examined) is far commoner in city men than in men from the country. There is, on the other hand, a long list of defects which are commoner in the country. Comparing town dwellers from different places, it is found that valvular heart diseases are roughly and inversely correlated to the density of population. State health officials will derive valuable information from these statistics with respect to the prevalence of particular diseases and defects in their several states. Thus, varicose veins are a serious problem in Minnesota and Wisconsin; trachoma is prevalent in Kentucky, Illinois, Indiana and Missouri; goitre is especially common in the vicinity of the Great Lakes; and so forth.

Naval and Military

Test of Coastal Railroad Gun.—The tests of our first 14-inch railroad mount at Fort Story, Cape Henry, Virginia, were so satisfactory that our coast artillery officers believe that all guns of this size will in the future be installed on railroad mounts wherever railroad equipment is available. With a 1,660-pound shell this gun has a range of 30,000 yards, but with an improved mount based upon the experience with the one just tested, the range will be raised to 40,000 yards.

Brest and Cherbourg as Commercial Ports.—We understand that Brest and Cherbourg, which were so well known to our overseas forces, are to be developed as commercial ports. Hitherto they have been monopolized by the Navy, but henceforth they are not only to become ports of call for trans-Atlantic traffic, but they are to be used for building fast passenger and cargo boats. Brest already possesses a large dock and landing facilities for the largest liners. Cherbourg is similarly well placed.

State of Completion of Ships.—Of the six battleships of the "Tennessee" class of 32,500 tons' displacement now under construction, the "Tennessee," on the first of October was 87.9 per cent completed, the "California" 76.5, the "Colorado" 32.5, the "Maryland" 54.3, the "Washington" 31.2, the "West Virginia" 26.3 per cent. Nothing has been done on the six 42,000-ton ships, nor has anything been done on the six battle-cruisers. Of eight scout cruisers, three were 5 per cent completed, two, 16 per cent, and three from 24 to 32 per cent completed.

Character of Future Naval Attack.—Rear Admiral W. F. Fullam summarizes the methods of naval attack of the future as: plunging fire from long-range guns; attack by bombing from aircraft; attack by submarine mines; attack by torpedoes fired either from submarines or destroyers or by torpedo planes. He believes that aircraft will become increasingly a determining factor in ranging, and he believes that sea power or fighting power will be largely dependent upon control of the air, and that the fleet which secures this control must win, other things being approximately equal.

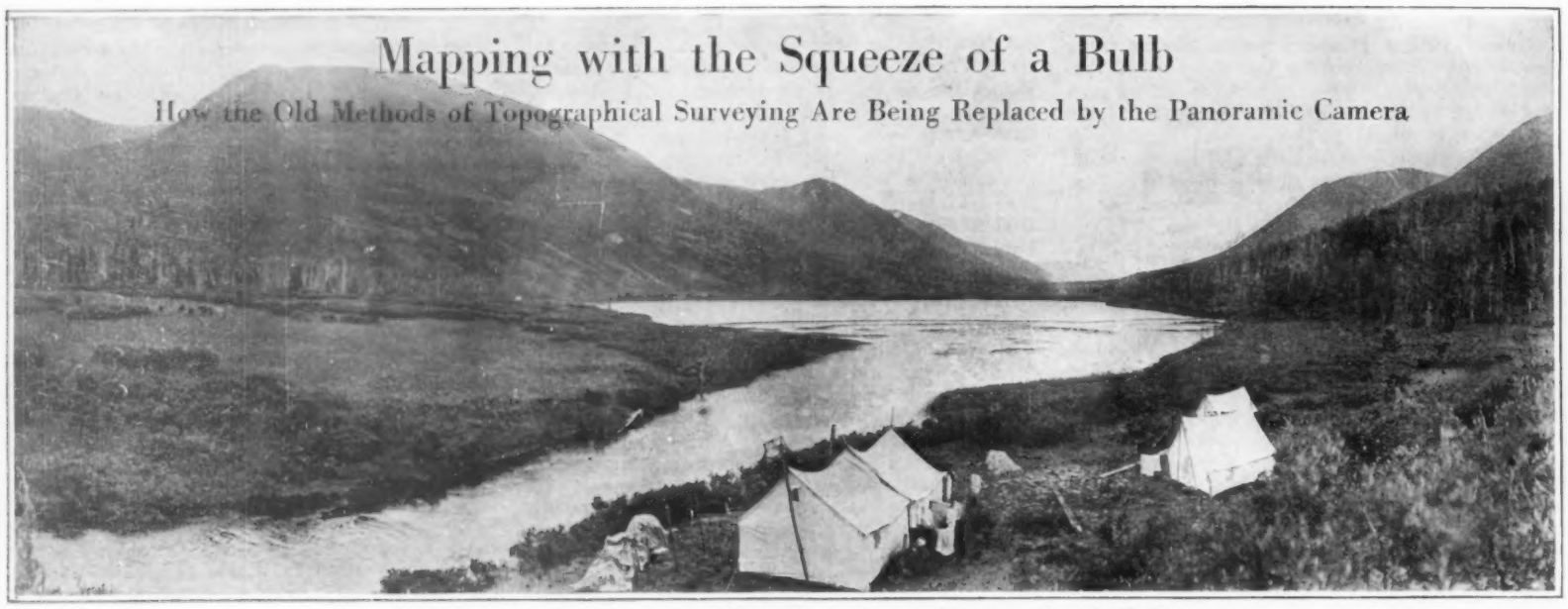
Esprit de Corps in the Army.—Every regiment of the United States Army has been asked by the Operations Division to submit a design to be placed upon its color or standard, such design to be symbolic of some point in the history of the regiment. This is being done in an effort to cultivate the *esprit de corps* of regimental and other organizations by memorializing its history. Under the plan proposed, says the *Army and Navy Journal*, each regiment would have on its color standard a coat-of-arms of the United States, its own organizational device, the names of all the wars in which it has engaged, and a symbol for each of its wars.

The French Abandon Steam-Driven Submarines.—The French, who were among the first to develop steam-driven submarines, are building no more of them, being convinced, according to J. B. Gautreau, that steam as a motive power does not lend itself to that rapidity of submersion, which is a fundamental asset of the submarine. According to this authority, the former troubles in building and operating Diesel engines were completely overcome during the war. The latest French class of 1,050 tons, originally designed for 4,000 horse-power engines, have instead been equipped with two 1,300 horse-power Diesel-Sulzers, giving a surface speed of about 18 knots and a radius of 7,000 miles at cruising speed.

Economy of Electric Drive.—A comparison of performance of the motive power of the "New Mexico" with that of other battleships shows marked economy in favor of the elctric drive. Thus, at 12 knots' speed, the consumption in tons of oil per day was for the "New Mexico" (electric drive) 75 tons, as compared with the "Arizona" for her cruising turbines, 100 tons and main turbines, 118, and the "Mississippi" for her cruising turbines, 99 tons, and for her main turbines 115 tons of oil per day. At 19 knots, the consumption of the "New Mexico" was 263 tons, of the "Mississippi" main turbines 305 tons, and of the "Idaho," main turbines, 310 tons per day. Similar economy was shown by the electrive drive at the intermediate speeds.

Mapping with the Squeeze of a Bulb

How the Old Methods of Topographical Surveying Are Being Replaced by the Panoramic Camera



Panoramic view of a typical camp of Uncle Sam's photographic map-makers in Alaska

YEARS ago the progress of settlement in extending westward over enormous areas of timber and prairie lands called for a development in surveying methods far beyond those of other countries and brought out the plane table as the most serviceable instrument for the work. As no better means were available, thought and energy were concentrated upon adding to and improving this instrument. The consequence was that a relatively large body of topographers became highly trained in this method of surveying, so that when in more recent years, surveys were extending farther into the mountainous regions of the West not only was little thought given to taking up other methods, but there was, in fact, little need for other devices, because of the skill and rapidity with which the surveys could be executed by use of the plane table. This was true of a very large part of the West that has been mapped. There were exceptions, however, which inspired the topographers with thoughts of improved methods of work, for in the desert mountains of the Southwest and in the northern Rockies there are large numbers of peaks, spurs, pinnacles, saddles, and slopes, details, which must be located on the map in order that the topography may be properly presented. The Grand Canyon of Colorado is another wonderful field for the employment of the camera in its topographic survey; and in Alaska this instrument becomes a necessity in topographic work.

The old method of mapping by the use of plane tables

In surveys of mountainous regions the factor which ordinarily has the greatest influence upon the progress of the survey is the time required for travel between stations. In most mountains the average radius of work from a station is the same for the camera as for the plane table, for this limit is determined by the amount of detail necessary for the scale of the map and the panoramic cameras supply photographs which have the necessary range. Therefore, in surveys of this kind the advantage which is gained from the use of the panoramic camera comes from an increase in the number of stations, the result of this increase being an improvement in the map.

In surveys of relatively small areas on a larger scale the time required for traveling between stations, though of considerable amount, does not have so great importance as it does in reconnaissance surveys, because the stations are placed closer together, and consequently a large number can be occupied in a working day. In surveys of this class the value of the panoramic camera depends more on the value of the contents of the photographs.

The panoramic camera now used for surveying is a wonderfully accurate and interesting instrument, in fact a new triumph of photography. It is made of aluminum and is inclosed in a protecting frame of mahogany lined with felt. The top of the box is the reference plane for leveling and the vertical axis carrying the lens is placed perpendicular to this plane. The circular film guides are adjusted so that when the film is in position for exposure all elements will be perpendicular to the level plane and hence parallel to the lens shaft. The greater range is given to the foreground in order to photograph all except precipitous slopes. Two seats at right angles to each other are arranged on the top of the box to receive a detached level bubble which permits a rapid adjustment for level. This adjustment is the only one that is necessary in using the camera.

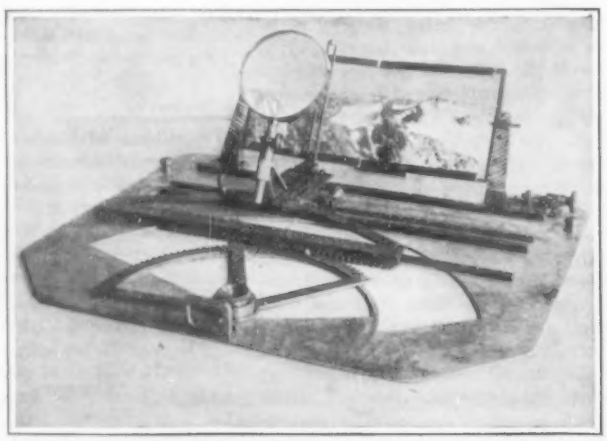
The lens is revolved by a spring, and the rate of revolution is regulated by detachable fans connected by gearing with the lens shaft.

Before using the camera a test is made by the surveyor to ascertain whether the proper relation exists between the lens shaft, film guides and level plane by exposing upon a field containing several prominent objects in the same horizontal plane with the lens. If the line passing through these several images is straight the proper relation exists, but if not the correction must be made before taking the camera to the field.

The manipulation of the camera is simple. At most stations it is necessary to shift the camera to one or two near-by positions in order best to photograph the country. When a camera is moved to near-by points the direction and distances from the station to the substations are noted. As a rough guide to the photographs the general direction of the view must be known. Some known point mentioned as "near center," or "20 degrees from left edge," adequately indicates the regulation of the negative to the map. The camera is equipped with guide lines on top which include a scope of 120 degrees. A mental note is made by the surveyor of distant objects in range with each of these lines for the camera's position during the first exposure. For the second exposure the camera is turned to embrace the field where the first left off. For the third exposure, a test sight is made as a check to see whether the field of the third view joins that of the first.

Photographic map making as pursued by Uncle Sam's surveyors in Alaska and elsewhere calls for the employment of two cameras by the topographic party. The photographer makes daily trips on one side of the course traveled, while the engineer and assistant work on the other side. The two cameras commonly occupy stations from five to ten miles apart in order to cover the maximum area, though they remain near enough together to close up the stretches between. The width of country which can thus be embraced in the

(Continued on page 47)



Panoramic photo-alidade employed to obtain upon the map sheet the location of points shown in the photographs

The panoramic camera used in topographic map-making

Footprints in Place of Fingerprints

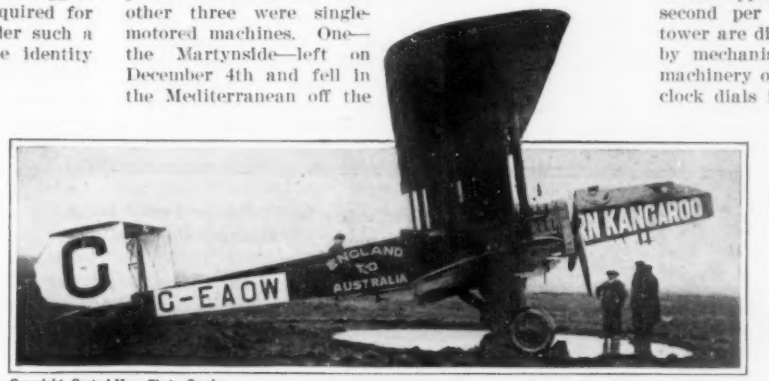
WHILE it has been suggested, alike seriously and by writers of detective fiction, that the markings of other portions of the anatomy than the finger tips are sufficiently permanent to serve equally well as a basis of identification, it has always seemed that the finger tips are so much the most convenient that there would hardly be occasion to employ any substitute or auxiliary for them. But it will be realized that in the case of small children, the toe prints are often quite as convenient to make and use as are the finger prints; so the Bureau of Missing Persons of New York City has decided to use them as a means of recording the identity of the tiny tots. The idea is that any parents who wish to be sure at all times of the identity of their offspring may take the children to the Bureau and have them toe-printed—or more properly foot-printed, since the impression is to be taken of the entire foot-bottom, rather than of the digital tips alone. Then if the infant turns up lost or kidnaped there need never be a repetition of the uncertainty which characterized a recent case, where one bereaved mother accepted as hers and kept for several days a found baby which turned out to have disappeared from another home altogether. Police of Baltimore and Chicago as well as of the metropolis are engaged in similar work; and it may not be too far a look into the future to suggest that some day birth certificates may be required for all children, with the prints attached. Under such a system, there could never be doubt of the identity of a strayed child or of one found dead.

A New York police head explaining footprint identification to a mother

The England-Australia Flight

WHEN the chronicles of the mechanical developments of the present century come to be collated and arranged by the future historian, what a brilliant record of achievement will be that of the airplane in this year of our Lord 1919. And how quickly it has all come about. The flight from Newfoundland to England overnight, as it were; the feat of climbing 6½ miles into the air, and now the 10,000-mile flight from England to Australia.

The $50,000 prize put up by the Government of Australia for a flight from England to that continent was won by Capt. Ross Smith and his brother Lieut. Keith Macpherson Smith, R.A.F., and Sergeants J. W. Bennett, A.F.M., M.S.M., and W. H. Shiers, A.F.M., their mechanics. They set out from Hounslow aerodrome the morning of November 12th in a Vickers-Vimy Bomber—a duplicate of the machine in which Capt. Sir John Alcock and Sir Arthur Whitten Brown (an American) flew across the Atlantic in 15 hours 57 minutes—and flew via Rome, Crete, the Mediterranean, Cairo, Bagdad, Delhi, Karachi, Calcutta, Rangoon, Singapore, Java, and Bima on the island of Sunbawa, to Port Darwin at the extreme northwestern part of Australia, a distance of 10,500 miles, in 28 days, arriving December 10th. They caught up with M. Poulet and M. Benoist on their twin Le Rhone-motored Caudron biplane at Rangoon, and passed them in a race to Singapore. The Frenchmen left Paris October 14th. The Blackburn "Kangaroo" was the third bi-motored plane in the contest. The other three were single-motored machines. One—the Martynside—left on December 4th and fell in the Mediterranean off the island of Corfu on the 10th, both Capt. G. C. Matthews and his mechanic being drowned. Another, the "Alliance P2," nose-dived to earth and killed Lieuts. Ross and Douglas when emerging from a cloud but 6 miles from Hounslow, which it left on November 13th. The third, the Sopwith "Wallaby"—a species of Kangaroo—left on October 21st, but had not progressed beyond Gonzenheim, near Mayence, according to last reports. It, as well as all other British machines except the Alliance, was fitted with a 375 horse-power Rolls-Royce motor. The race has emphasized the advantage of multiple-motored machines such as were first advocated by Mr. Edwin Gould, who donated the Gould-Scientific American $10,000 prize for the first twin-motored airplane in 1911. The late Howard Gill produced such a machine and flew it successfully. Four and six motors are not uncommon on the airplanes of today; the more the safer.



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The Blackburn "Kangaroo," which was entered in the England-Australia flight

Cleaning One of the World's Largest Clocks

THE great clock of the Houses of Parliament has always been one of the most interesting features connected with this great edifice. When the immense structure was commenced, it was resolved that both the clock and the hour bell should be the largest ever seen in the United Kingdom. After construction had progressed on the building as a whole, the late Sir Charles Barry solicited tenders, in 1844, for the construction of the clock and the bell. Like all public works, there was a great deal of wrangling before the contract was finally let, and it was not until 1859 that the clock was performing its functions.

Big Ben, as the clock is called, is one of the largest and most accurate in the world. The weights hang down a shaft 160 feet deep, and are rewound once a week. The pendulum is 15 feet long, and weighs 680 pounds, and is so delicate in its action that a small weight of only one ounce placed on a particular part of the apparatus will alter the rate of the clock one second per week. On the four sides of the clock tower are dial rooms, each a large apartment traversed by mechanism which communicates motion from the machinery of the clock to the hands. Each of the four clock dials is 22½ feet in diameter and the cast-iron framework of each dial weighs no less than four tons. The hour figures are two feet high and six feet apart, and the minute marks are 14 inches apart. The outer point of the minute-hand makes a sudden leap of 7 inches every half minute. The hands weigh more than 200 pounds for the pair. The minute-hand is 16 feet long, and the hour hands, 9 feet long. In order to render the dials visible at night, each dial face is glazed with enamelled or opalized glass which was formerly lighted by 60 gas jets, but probably a more convenient electric light has now been substituted.

The machinery was constructed in a most careful and painstaking manner under the direction of the Astronomer Royal, for astronomy and time-keeping have always gone hand in hand. The Astronomer Royal at the time was Professor Airey. The clock has just been overhauled, and several years have been taken for the operation, which is most thorough. Every portion of it has been cleaned and repaired so that it is good for the next 50 years, in all probability.

Such is the magnificent clock for which suitable bells had to be cast. The original scheme was for "a clock that would strike the hours on a bell of eight

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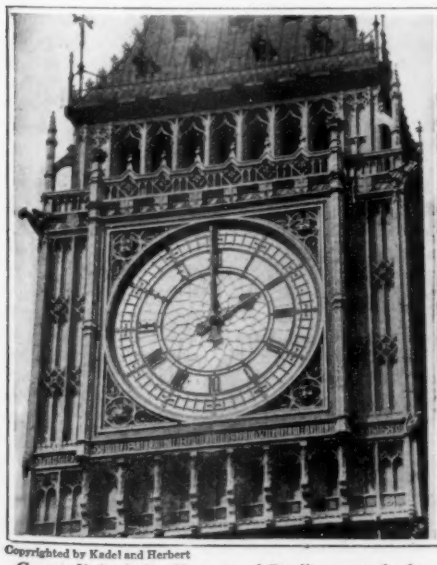

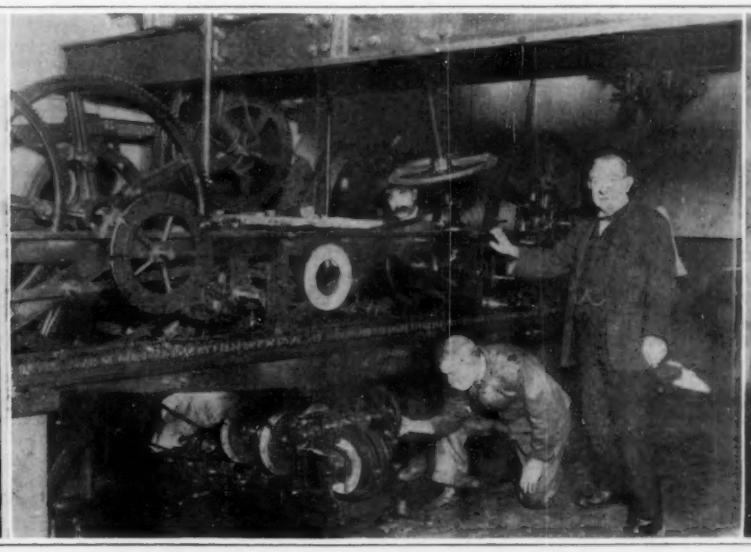

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Great dial of the Houses of Parliament clock

Time and chime trains of the great clock of the Houses of Parliament, London

Clock mechanics grooming one of the hands

A Governmental Step-Child

Struggles of the Patent Office to Make a Nineteenth Century Wage Scale Serve the Twentieth

"RESIGNATIONS of examiners contributed to augment the number of cases on hand. Strong inducement must be held out to these officers to retain their posts. More room, better facilities for transacting business, and more examiners are needed. The office has not been wanting in representing the evil to those who had it in their power to repair it and did it not."

Thus wrote Silas Henry Hodges, Commissioner of Patents, in his report of February 28, 1853, and he was neither the first nor the last commissioner to bewail the distressing conditions of the Patent Office. From the time of the very first commissioner, Henry L. Ellsworth, down to the present day, there has been a constant plea for recognition of the services of the Patent Office before Congress, but our Senators and Representatives have always been so concerned with other interests, and so blind to the fact that patent business means anything to the country, that the crying needs of the Patent Office have received scant consideration. To be sure, Congress has made appropriations; but so grudgingly and tardily have these been given that the Patent Office has always been kept in a state of impoverishment; and yet this office is actually one of the most important institutions of our government. Under its fostering protection "Yankee" ingenuity has been so highly developed that its reputation is world-wide. The Patent Office has done more to further the march of progress than any other agency, and yet there is no office of the government that is treated more shabbily. Commissioner after commissioner has plead before a Congress for better working conditions, more help, and decent living wages for the devoted staff of workers who have stuck to their posts despite trying conditions and serious handicaps. It is high time that public opinion was aroused to enforce a betterment of conditions. It is not as if the Patent Office were a burden on the Government; it is one of the few offices that actually earn money in excess of its expenses, and these earnings must all be turned into the United States Treasury to help pay other expenses of the Government while the Patent Office itself goes begging. In the past few years the Office has turned in more than eight million dollars and yet recently when the Hall of Models had to be sacrificed to furnish more working room, the chairs and desks provided were the old worn-out furniture cast off by the Pension Office!

ONE of the things that few Congressmen have taken the trouble to learn is the extent to which American industry is dependent upon the patent system, and therefore upon an efficient administration of the Patent Office. Congressional indifference is such that adequate appropriations for the support of the Patent Office seem unobtainable; and in this era of high prices the result is that the best examiners are forced to resign and seek more remunerative employment elsewhere. This article, and another which will follow, seeks to make clear just what desperate conditions exist in the Patent Office as the result of this, and what would constitute adequate measures of relief.—THE EDITOR.

The situation just now is more serious than ever, because of the extraordinary conditions brought on by the war. In the first place there was the enormous demand for men in all Government departments and bureaus directly concerned with the war. This robbed the Patent Office of a large part of its force. Not only was the examining force depleted but there were serious drafts on other members of the force—stenographers, clerks and other assistants—who could get far more pay in other governmental work. Naturally, they deserted the Patent Office. This threw a greater burden upon the shoulders of those who remained, and while they were allowed a bonus during the war, to cover increased living expenses, it was wholly inadequate to compete with the salaries offered by other branches of the government, so that many of the very best workers were lost.

During the war patent applications for peace time inventions fell off to a considerable extent, but there was a big rush of war inventions which brought up the number of applications almost to normal. Now that the war is over there is a great rush of business from inventors who let their ideas lie dormant while the great conflict was on. The increase of applications so far this year over last year amounts to about 33 per cent, or something like 25 per cent above normal.

The "Big Deed" from the Alien Property Custodian to the Chemical Foundations, Incorporated, transferred about five thousand patent applications and trade marks which had to be recorded in the Patent Office. In addition to these there were seven or eight thousand demands and seizures filed by the Alien Property Custodian, all of which set back the work in other divisions of the Patent Office. It is anticipated that when the peace treaty is signed there will be a flood of applications from Germany and Austria. Under the terms of the treaty, applications which were filed during the war may be entered in the Patent Offices of our Allies and the United States within a year's time, and if this portion of the treaty is endorsed by act of Congress, we shall have a mass of accumulated patents as well as new Austrian and German applications to be filed in the Patent Office, and to add to the enormously increased number of applications that the Patent Office now has to deal with.

Another big increase of work is in the Trade Mark Division. With the expansion of our commerce to foreign markets, American manufacturers have found it necesssary to file their trade marks in this country. Our laws make it necessary for a trade mark to be used before it is filed. In foreign countries, however, the first person who makes application for trade mark registration receives the protection of that particular government. And so it happens that many unscrupulous persons are taking American trade marks and registering them under their own names in foreign countries, although from our point of view, they have absolutely no right to do so. Many of these countries are now requiring that the trade mark must also be registered in this country before it can be registered abroad. This year applications in the Trade Mark Division run 75 per cent above normal.

This unprecedented amount of work has fallen upon the Patent Office when its force is sadly crippled. Many are leaving the force because of the tremendous pressure of work, and also because very attractive offers are held up to them in private employment.

There has been an enormous turn-over of labor. In the month of September last, for instance, there were twenty resignations from a force of four hundred men. The annual turn-over for the present year, based on reports for the first ten months, will amount to more than fifty per cent. The Civil Service cannot supply men to fill the vacancies in the examining force. To be sure the Commissioner has been able to fill the vacancies by emergency appointment, using college graduates without any Patent Office experience. It takes at least six months to break a man into the work of examining patent applications. The fourth assistant examiners receive $1,700 per year. When we estimate that half of this amount is paid the man while he is learning to perform his work, and also that the services of another man are required to train him in the work, it may readily be estimated that it costs the government something like $1,000 for every examiner lost from the force. A few years ago the salaries of the members of the examining force were all raised about $250, but with the present salaries ranging from $1,700 for fourth assistant examiners to $2,740 for a principal examiner, these men are insufficiently paid.

There is a growing demand for these men in private employment. On account of the increase in the number of inventors seeking patent protection, there has been a greater demand for patent examiners and the only field from which such men can be obtained is the Patent Office. Consequently the loss to the Patent Office, when one of the examiners resigns, is two-fold, for when an examiner leaves the rest of the force have not only to carry on the work that was formerly done by this examiner, but also the new work which he will send into the office. It is like a tug of war in which members from one side not only desert their own team but actually go over to the other side and increase the work of their own team in maintaining its position. This is most disheartening to the remaining members of the Patent Office "team," but they have stuck doggedly to their posts and are still tugging valiantly against frightful odds. Why does not Congress help such devoted men?

We cannot class the examiner who leaves, as a deserter. No one can blame the man for leaving the Patent Office when we consider the entirely inadequate pay he receives there and the bright opportunities that are offered him outside. The following is a quotation from a letter of resignation recently tendered by a primary examiner:

"It is with sincere regret and much reluctance that I sever my connection with the office. I entered the corps with the intention of remaining, and were financial conditions different I would not now think of resigning. The position I hold is one of dignity and importance, and the work is interesting, and the associations are most pleasant. The salary, however, is insufficient to meet my reasonable expenses and give my children an education equal to that of their parents, to say nothing of its failure to correspond with the character of the position. In view of the great advance in salary and the excellent prospects afforded in the position offered me outside the office, I feel under obligations to accept such offer."

This man left arduous work with inadequate facilities, at a salary of $2,740, to accept a position paying him $5,000. He severed his connection with the Patent Office reluctantly because he liked the work there, and his associations were most pleasant. But insufficient salary to meet his expenses and to provide his children with an education equal to his own, made it imperative.

Strengthening Rail Joints by Heat Treatment

AN interesting contribution to the discussion as to how to strengthen steel rails is that of a Pennsylvania Railroad experience to the effect that plain angle bars, if heat-treated, can make a rail-joint having strength and efficiency equal to that of the solid rail. Heat-treatment, according to him, produces an increase in elastic limit ranging from 60 per cent in solid 100-pound rails, to 79 and 150 per cent in plain angle-bar joints with six and four bolt-holes respectively. In the rail the elastic limit was raised from 175,000 to 280,000 pounds, while in the bars it was raised from 70,000 and 50,000 pounds to 125,000 pounds in both cases. From this the conclusion is drawn that heat treatment was one of the simplest and most economical means of increasing the efficiency of the joint. The treatment mentioned consisted in heating the material above the recalescence point (about 1,500 degrees Fahrenheit), quenching in water, and then annealing the hardened steel at about 1,050 degrees Fah. The report also points out that a joint equal in efficiency to the solid rail can be obtained by heat treatment of some of the patented types of rail joints, or at less cost by a similar treatment of a special angle bar. The joint with this bar showed a strength at the elastic limit equal to that of the rail, and would cost less than the standard angle bar which had a strength of about 33 per cent that of the rail. The new bar was to be used with heat-treated fish bolts, as being shorter than the standard bar it might require greater bolt strength. Comparison of joints having four and six bolts respectively indicated that the two additional bolts gave no increase in strength in transverse loading. It was concluded that a four-hole fishplate is sufficient for a 100-pound rail if it is of proper section and material. As to fishplates 26½ inches and 18½ inches long, tests with 20-inch and 26-inch spacing of sleepers indicated no loss of efficiency in the point with the shorter fishplates.

Hardness of Materials Tested by Drilling

SINCE there is hardly any generally accepted definition of hardness and the hardness tests of Brinell, Ludwik, by scratching acid, and by the scleroscope are not concordant, Professor Kessner proposes in a German paper a drilling test by which he determines what he calls the "workability" of a material. This term is to refer to the ease with which the material lends itself to being worked, drawn, rolled, hammered, etc. That a drill test should be particularly characteristic of this property, is not self evident. But Kessner finds that his drill test indicates the increase in the lead percentage on a brass, when the Brinell hardness afforded no clue. In the case of steel the resistance to cutting tools depends both upon the hardness and upon the workability; the latter decreases in general with increasing carbon percentage as the elongation does while the Brinell hardness increases with rising carbon.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A French Saw

To the Editor of the SCIENTIFIC AMERICAN:

Permit me now to rectify what you said in the number of August 2, page 116, about a 3-foot saw which fits in any pocket. Your correspondent, who must be a young soldier, was surprised to find on some battle field a regular *scie articulée* of the French army which he thought to be German. This articulated saw is in constant use by us for twenty years, and every French soldier is accustomed to use it. The two holes at both ends are provided for receiving a small piece of wood as a handle. P. BOURDON.

Livet, France.

Shipping Wood

To the Editor of the SCIENTIFIC AMERICAN:

Reading about burning the profits in the lumber mills refuse burner, Aug. 2nd, I should like to offer a part of the comment of a gentleman in London, England, on the refuse burner.

He says: "Over here wood is more than wood; it is a commodity so scarce that packing cases, for example are virtually unprocurable, and four cents a pound is being paid for kindling wood for household purposes."

As a large number of lumber mills is located at tide water, I suggest that solid waste wood be shipped to large cities by water and cut up to kindling wood. Perhaps there is a market right in New York City.

V. HANSEN.

Wallace, Ida.

Saving Shoes

To the Editor of the SCIENTIFIC AMERICAN:

I was interested in the article by Mr. F. W. Charles in a recent SCIENTIFIC AMERICAN, because I think I have an improvement on this method.

My plan is to apply a liberal coating of vaseline to the soles of the shoes, then hold them over a warm stove or register for a few minutes, when the vaseline will be found to have entirely dried in and the shoes are in condition to be worn at once.

I have used this method for some years and find that if the application is made two or three times in a season, no dampness will penetrate the sole and the leather will wear much longer than otherwise.

If the heels are rubber do not apply the vaseline to them. JOHN J. SHAW.

Plymouth, Mass.

When the Coal Is All Gone

To the Editor of the SCIENTIFIC AMERICAN:

Will you please let me tell some of your trembling correspondents to ask the Dutch millwrights what we must do to be saved when the mines are exhausted? There is no coal in Holland and few running streams, and yet they run great flouring mills—as well as little grist mills—and don't burn a pound of coal.

If they will leave it to the Dutch engineers we shall never have to dig up the earth's surface 30 miles deep to get radium to keep us from freezing!

Or let them give a contract to a Yankee cantilever bridge engineer for windmills of 100-foot radius, self-regulating like a farmer's pumping outfit. He would build them without falsework.

Turn those Dutch millwrights and hydraulic engineers loose on Lake Michigan and give them reservoir room on the bluffs and see what they would do to it if the War Department would let them alone. But, of course, as long as the object would be to get energy to take the place of coal, instead of making more farming land, the level of the lake would not change appreciably.

I hardly think it will be necessary to mine radium if the winds continue to blow.

I should like to tell those "scientists" who are shivering over the prospect of exhausted coal mines that we could make a Gatun lake out of the western end of Kansas—I wouldn't give ten cents an acre for it—and let the water come down in orderly fashion through turbines, instead of like a drunken mob doing millions of dollars' worth of damage every year. We could get energy enough there to warm the better part of that state. Make the rivers do useful work instead of destroying enough property every year to pay the National debt and it will go quite a way toward keeping the people from freezing.

I wonder if any one imagines that storage batteries can never be made cheaper and more durable than they are now. Accumulators with windmills would make a combination that would take the place of all the coal that was ever mined.

It seems to me that it would be a very stupid thing to bore wells 30 miles deep and pipe the heat to the surface—it's of more use where it is. I am not saying that it would be impossible—that expression is becoming obsolete.

The energy of a hundred Niagaras is going to waste in every State of the Union all the time.

W. A. MOSELEY.

Buena Vista (Miami), Fla.

The Private Car Question

To the Editor of the SCIENTIFIC AMERICAN:

In an editorial headed "Who Shall Own the Cars?" the SCIENTIFIC AMERICAN of September 13th presents a discussion of the American meat packers and their interest in refrigerator cars. This editorial says: "There exists here a monopoly which is utterly indefensible on every ground of public policy. It should be possible for any man who can pay the freight to ship meat as freely as he can ship anything else."

Such freedom of shipment is not hampered by the meat packers. Every transportation which the big packers have is open to everybody else. The packers' cars move on the same trains and are treated in the same way as the cars of competitors. It is undoubtedly true that service rendered to shippers by the railroads does not approximate the service which shippers are able to obtain if they own their cars. The mileage of packers' cars is greater than that of others; not because of a special privilege, but because the packers follow up their cars at every turn; loads are always ready; cars are never kept waiting.

To improve the existing system, it would be natural to increase the number of refrigerator cars in operation and to bring them all up to the standard of the packers' organizations. It would not help consumer or producer to make the packer as inefficient in operating cars as the railroads. The Interstate Commerce Commission investigated fully over a period of years and reported, on July 31, 1918, that there were no arrangements which gave the owners of private cars any unfair advantages.

The Commission on page 673 of its report, said: "The system of the use and supply of private ownership cannot be at once and radically changed without serious consequences to shippers, carriers and the public." And on page 683: "The requirement has been that there shall be the most efficient use of tank and refrigerator cars, which has been one of the results of private ownership. While this has undoubtedly been of benefit to carriers, it has been of incalculable benefit to shippers as well." The Commission expressly said, on page 691 of its report, "These great shippers of perishable articles have used to the fullest extent their splendidly effective organizations to secure prompt service for their cars used in shipments of their products."

This accounts for the Federal Trade Commission's discovery that the mileage of "independents" is 54.5 miles a day, whereas the mileage of the packers is 80.8 miles a day. In putting packers on the same basis as firms which do not own cars, there is no question of eliminating unfair privilege. There is merely the question of disrupting efficient organization and reducing the mileage of packers' cars to 54.5 miles a day. Is this fair to any interest? Most of all, is it fair to the public?

Only one motive prompted the packers to invest in refrigerator cars—to obtain efficient service for fresh meat. The railroads refused to construct enough cars, and the packing firms were actually forced to provide their own facilities. These cars have often been operated at a loss and they have never been an attractive investment.

Every transportation service which the big packers have is open to everybody else. The packers' cars move on the same trains and they do not enjoy preferential freight rates. They do not gain unfair advantage by putting non-perishable products into refrigerator cars. All shippers who want refrigerator cars must guarantee to the railroads a certain weight of perishable products to a certain destination. The guaranteed weight must be paid whether the car carries a full load or a half load.

If the packers' perishable goods do not fill the car, he usually puts in other available products. But the non-perishable articles must be paid for as if they were sent by ordinary freight, at standard less-than-carload rates. The weight of the extra goods cannot be included as part of the guaranteed weight, and consequently it represents additional cost to the packer.

In war times the Railroad Administration insisted upon having every car loaded to the limit. The packer's habit of sending capacity loads costs him extra freight charges, but it results in saving for the transportation system and for the public. This is one of the best ways to avoid car shortages, and it is based on the most advanced theory of economical transportation.

The SCIENTIFIC AMERICAN refers to the large packers as controlling practically all the meat industry of the country. A wrong impression has been generally circulated about the packers. The five large firms handle 40 per cent of the total meat supply of the country, and about 61 per cent of the total output of federally inspected plants. They do not constitute a monopoly, nor have they any trade agreements.

We are extremely anxious to make this explanation, and we hope that it will be satisfactory to the SCIENTIFIC AMERICAN and its readers. The packers are gravely concerned with maintaining the present high standard of efficiency in the meat industry, and they believe that a convincing justification of present organization lies in a full statement of all the facts.

BUREAU OF PUBLIC RELATIONS.
AMERICAN MEAT PACKERS' ASSOCIATION.

Chicago.

A Graphical Representation of Geologic Time

A GEOLOGIST has been defined as one who is perfectly contented if given an unlimited amount of the commodity for which other persons have the least use—past time; and among the questions that geologists are expected to answer the most frequent are those in which the time element is concerned. What is the age of the world? How old are certain fossil remains? How long ago in the world's history did this or that event take place?

Disappointment or impatience are commonly expressed because definite figures are not forthcoming in reply to these and similar questions; yet a majority of people are incredulous or skeptical if tens or hundreds of thousands of years are mentioned in connection with recent geologic events, and millions of years in connection with those that preceded them. The average person has only a vague conception of the extent of geologic time or the slowness of biologic evolution and physiographic development; and it is difficult for the finite mind to grasp the meaning of millions, when applied to years, unless the figures can be visualized by some scale of comparison or by some method of diagrammatic representation.

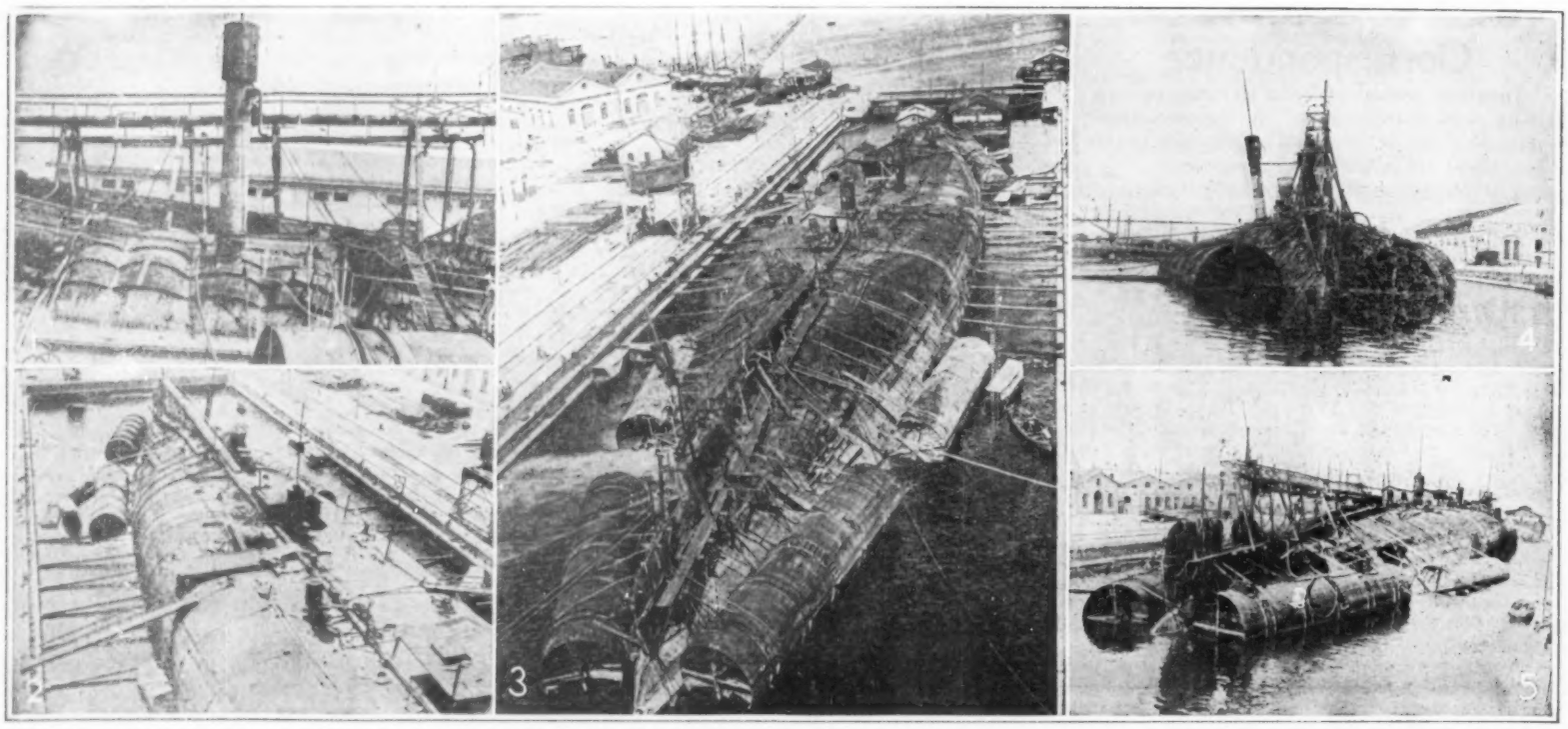
A method has been utilized by the writer in lectures, apparently with satisfactory results, and the editors tell him that they have seen a similar device employed by other instructors with success. The basic idea is that a clock or chart is made to convey an idea of the time factor (see page 31) by translating years into terms of hours and minutes. This chart is based upon (1) an assumed age for the earth of 72 million years, which is a fair average of the many estimates made by physicists and geologists, and (2) the ratios between the several geologic time divisions as estimated by geological authorities.

The clock dial, representing the age of the earth, or the cosmic day, is divided into 24 hours, hence each hour is equivalent to three million years of geologic time. The estimates of the geologic time ratios are to the effect that Pre-Paleozoic, Paleozoic, and Mesozoic time are respectively twelve, eight and three times the duration of Neozoic time, in which we live today. If these ratios are applied to the hour divisions of the clock dial we have:

Pre-Paleozoic time,	12 hours	= 36,000,000	years
Paleozoic time,	8 "	= 24,000,000	"
Mesozoic time,	3 "	= 9,000,000	"
Neozoic time,	1 hour	= 3,000,000	"

By subdividing each of the time divisions into its appropriate geologic periods the approximate antiquity of each period is indicated.

The even subdivision of Pre-Paleozoic time into Azoic and Eozoic is purely arbitrary, as is also the indicated time duration of the several geologic periods, except in connection with the Quaternary, which is assumed to include the last 500,000 years of cosmic time, equivalent to the last ten minutes of the twenty-fourth hour, and to represent the time that has elapsed since the appearance of man; and if any one should wish to indicate the historical period of human affairs it would be represented approximately by the final twelve seconds of the dial.—*Arthur Hollick.*



1. Airlock for entering hull. 2. View looking forward. 3. The "Leonardo" in dry dock, centered in position ready for pumping. 4. Stern view showing two of the cylindrical pontoons. 5. Note in this view the two balanced rudders.

The salving of the Italian 22,500-ton dreadnought "Leonardo da Vinci" mounting thirteen 12-inch guns

Saving a Capsized Dreadnought

From Wrong Side Up to Right Side Up: The Remarkable Case of the "Leonardo da Vinci"

ONE of the material tragedies of the war was the sinking, through explosion, of the Italian warship "Leonardo da Vinci." At the time, this, one of the latest Italian dreadnoughts and the first ship to carry thirteen big caliber guns, was anchored in the center of the Mar Piccolo in about 36 feet of water. The disaster was due to that frequent cause, explosion in the magazines, which, in this case, ripped two great holes through the hull into which the water poured so rapidly that in a few minutes the ship turned completely over and sank bottom up, the deck structures and the gun turrets burying themselves in the mud. Only a small length of the keel forward remained above water. So suddenly did the ship go down that 249 of the crew, including 21 officers and Captain Sammi Picenardi were lost.

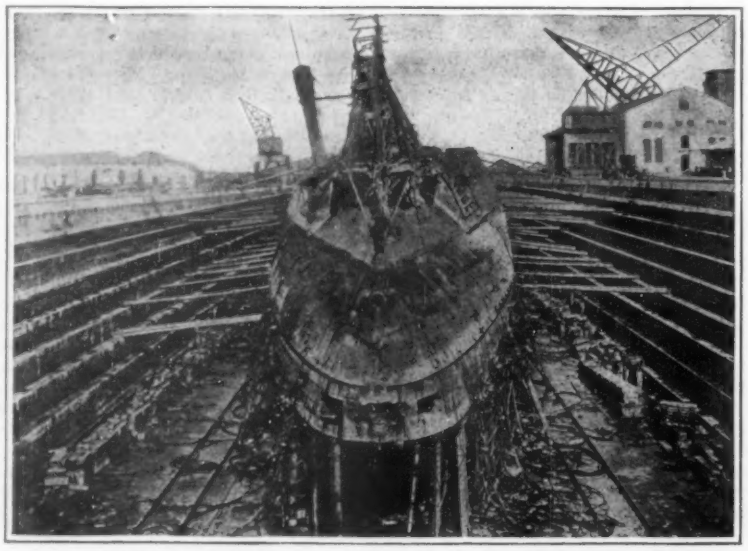
Thanks to the fortuitous circumstance that this great ship sank quite close to an arsenal and in sheltered water, it was possible to salve her. This was done by the well-known pneumatic method. First of all, the great rents torn in the vessel's hull were plated up and all openings into the ship were closed. Then, powerful air-compressing machinery was installed, some of the plant being placed on the outside of the bottom (now the top) of the ship, and the process of lowering the water within the tightly-closed hull commenced. The first fall, which was to 21 feet below water level, was done by three compressors driven by gas engines. Encouraged by this, the pneumatic plant was enlarged by using additional compressors driven by electric motors, the latter being coupled up with the electric power station ashore by submarine cables.

The first effort was directed to saving the shells and other munitions, and to this end air locks were built, leading from the open down into the magazines. These are the stovepipe-looking erections which will be noticed in some of the photographs. After the additional electric pneumatic plant had been put in, the water was lowered throughout practically the whole of the ship to 26 feet below water level, and all of the munitions in the forward and center magazines were salvaged. After that the coal was recovered. At that time the divers commenced plugging all the openings, such as port holes, scuppers, et cetera, in the upper (now the lower) part of the hull, the two large rents caused by the explosion in the stern of the ship, each 32 feet in length by 16 feet in height, being already plated up.

The work commenced in the spring of 1917, and after the water had been lowered as stated above, the next task was to remove the five turrets and their 12-inch guns; for the ship having turned over in 36 feet of water, the turrets and their guns were naturally very deep in the mud. However, after much difficulty, these were released, as was also the barbette of Number Two turret, which was loftier than the others on the ship. This heavy material having been cut loose, and the ship lightened by the removal of her coal and munitions, everything was ready for the final effort, which was directed to getting the huge inverted mass into a dry dock.

At the close of 1918, such experience had been gained in the work under air pressure that every part of the ship could be made accessible. The greater part of the fore deck was rendered water-tight and the turrets being free of the ship, the two funnels were completely removed and work was carried out quite freely on the spar-deck under pneumatic pressure.

The next step was to attach by steel cables, eight large cylinders, four at the bow and four at the stern, as shown in our various illustrations. The bow cylinders were attached by raising the bow of the ship by means of air pressure, and then the after cylinders by lifting the stern.



The "Leonardo da Vinci" resting upside down upon trestles and blocking in dry dock

Perhaps the most original thing about this great job of salvage was the determination to dock the battleship upside down, that is to say, to float her into dock in the overturned position; place her upon a staging and blocking suitable to receive her in this condition; make such repairs as were necessary, and then turn her right side up again, ready for the replacing of turrets, guns and structures.

The work of figuring out the proper height of the massive timber posts upon which this huge weight of 15,000 to 20,000 tons was to be carried required, naturally, very great care. The bulk of the weight of the ship was carried upon an outer line of double posts of very heavy timbers, which extended entirely around the perimeter of the ship. Our view taken from the stern of the vessel shows the supporting trestle work very clearly.

It was on September 17, 1919, that, everything being ready, both in the dry dock and on the ship itself, the remaining water was pumped out until she was afloat, and the vessel was towed upside down for a distance of a mile and a quarter and taken to the dry dock. Here the ship remained floating for two days and nights, under compressed air, while the personnel of the dock was giving the final touch to the trestle work and blocking. On October 6th, the "Leonardo da Vinci" was in dry dock, completely dry. The next step was to clean out all the interior of the ship, plug all openings below, including a great hole torn by the explosion through the deck between the two after-turrets. When she has been made water-tight she will be floated out of dock, still upside down, without requiring any compressed air, and after she has been towed into sufficiently deep water, she will be rolled over into her normal position by pumping water into the tanks along the side of the vessel.

The turrets will be picked up from the mud by means of a special float designed by Maj. Giannelli Edoardo, of the R. Corps of Naval Constructors, who was responsible for all the work in connection with the salving of the battleship. For the foregoing particulars we were indebted to the *Illustrated London News*.

Revival of Our Oldest Navy Yard

United States Submarine Building Activities at the Portsmouth Navy Yard

Length: 231 ft. *Beam:* 21.5 ft. *Draft:* 12.5 ft. *Speed:* At surface, 14.7 knots; submerged, 12.4 knots. *Cruising radius:* 10,000 knots at 11 knots.

Trial run of the U. S. Submarine S-3

THIS story has to do with the revival of our most historic navy yard and its adaptation for the construction of submarines by the Navy Department. Previous to the war the Navy Department determined the size, speed and general characteristics of our submarines and left the designing of the details and the construction work to be done under contract by private firms that specialized in this class of work. Today, the Department, through its Bureaus is designing its own submarines, getting out the full working plans and building them at its own navy yard. The first of the new vessels to be turned out under this arrangement proved to be a brilliant success. This does not mean that the Navy will place no more contracts with private firms, but it does mean that it is working to a point where ultimately the whole of the designing and building of its submarines will be entirely in its own hands. The old Portsmouth Navy Yord has been selected as our principal submarine-building base, and work of this character has for some time been in full swing under Commander H. S. Howard as naval constructor.

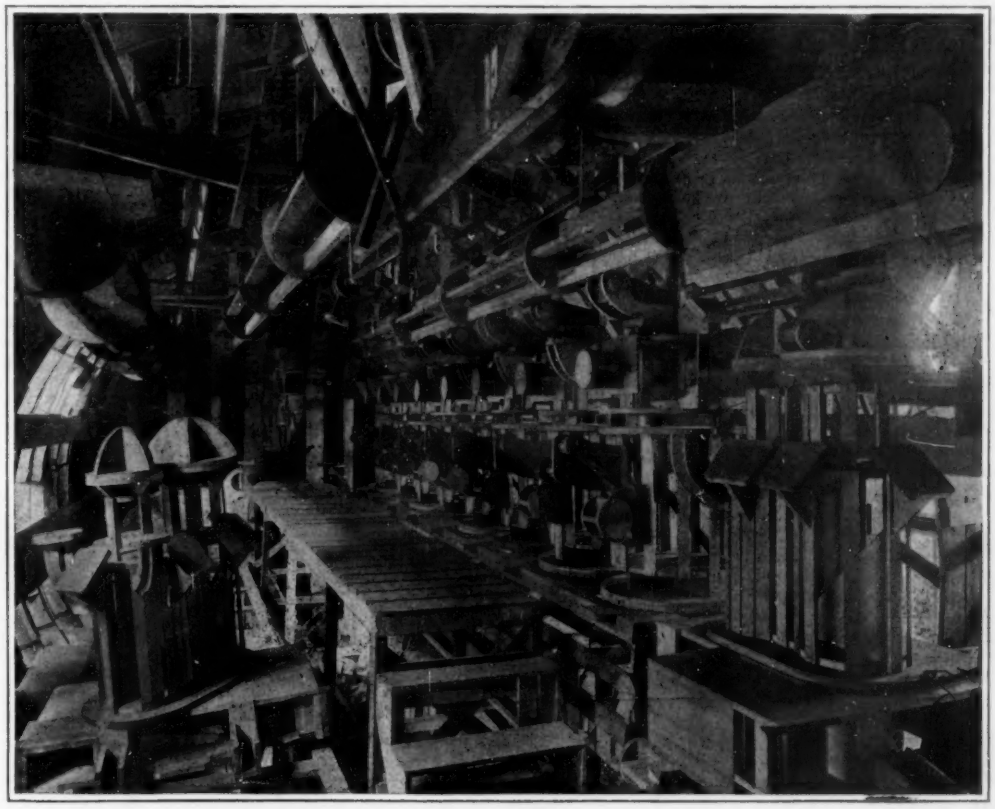
Because of its historic interest, we will first delve a little into the records of this, our earliest navy yard. In the spring of 1603, one Martin Pring, in command of two small vessels, left Bristol, England, and ultimately arrived at the Piscataqua River. Then, in 1621, came Captain John Mason of London, who erected a post house at Odiornes Point, which is believed to be the first house built in New Hampshire. Following him came, in 1645, one Richard Vines, acting for Sir Ferdinando Gorges, who was granted by Charles I, King of England, in 1639, a vast portion of the country of America, commonly called New England. In 1645, Vines granted two islands now known as Navy Yard and Seavey's Island, on which the Portsmouth Navy Yard is situated, to one Thomas Furnell, shipwright, for a yearly rent of two shillings and six pence. Shipbuilding was an early and active branch of industry on the Piscataqua, and in 1690, the "Falkland," a 54-gun ship, the first ship of war built on this side of the Atlantic, was constructed by a Mr. John Taylor, by order of the British Government. Following her, came the "Bedford," 32 guns, built in 1696. The third war vessel launched at Portsmouth was the "America," 44 guns, which took the water in 1749.

Congress authorized and passed an act in 1775 for the building of thirteen cruisers, and the first ship to be built for the Continental Navy, at Portsmouth, was the "Raleigh," 32 guns. The next ship was the "Ranger," a sloop of war mounting sixteen 6-pounders. This vessel will ever be famous because it was identified with the sea service of one Paul Jones. It was on the 14th of February, 1778, that Paul Jones, in command of the "Ranger," received the first salute to the Stars and Stripes of the United States of America.

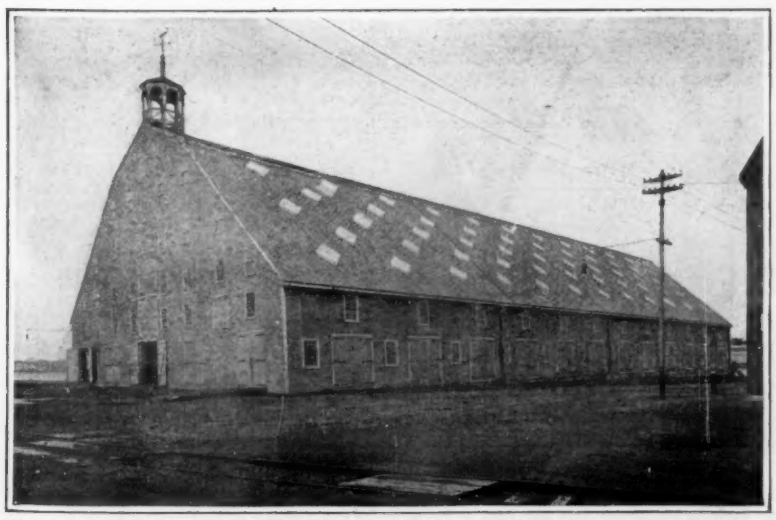
Immediately following the creation of the Navy Department and the appointment of a Secretary of the Navy, the Government determined to own its own navy yards, and on the 12th day of June, 1800, the present site of the Portsmouth Navy Yard was purchased for the sum of $5,500. A notable day in the history of the yard was April 1, 1813, when Commodore Hull assumed command of the Portsmouth Yard, and on the 9th of April, the Secretary of the Navy for the first time addressed Hull as "Commandant of the Navy Yard, Portsmouth, New Hampshire." Two years later the "Washington," a frigate of 74 guns, was launched and fitted out as a flagship for Commodore Chauncey, who took command of our squadron in the Mediterranean. It was in 1818 that the house which had been fitted out for the Commandant from the old building originally on the island was remodelled and rebuilt and the grounds enclosed. This is the fine residence which is today occupied by the Commandant.

The Franklin Shiphouse, of which we present an illustration, was completed in 1838. The first ship to be built in it was the sloop of war "Preble." On the same ways, and therefore within this famous old

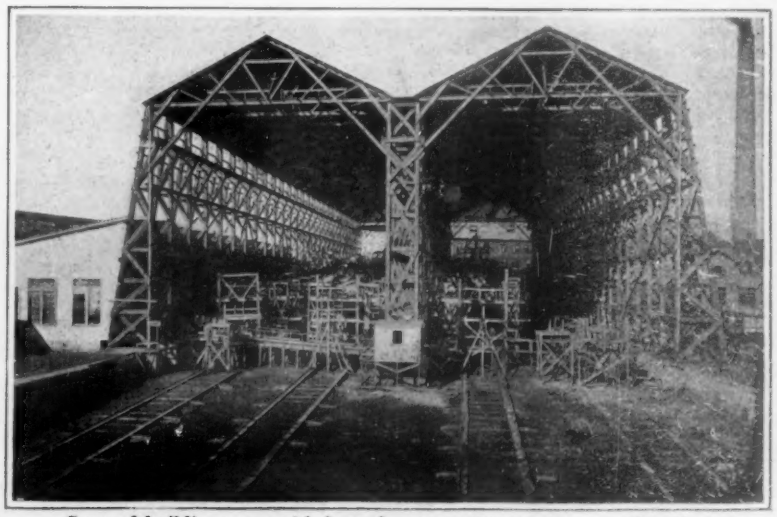
(Continued on page 47)



Full-size pattern of a submarine in wood, with everything in place as in the finished vessel. This saves a large amount of work when the finished parts are being assembled in the steel hull



The Franklin Shiphouse. Built of timber in 1838. Under its shelter were built many vessels of our wooden navy. It is in a fine state of preservation

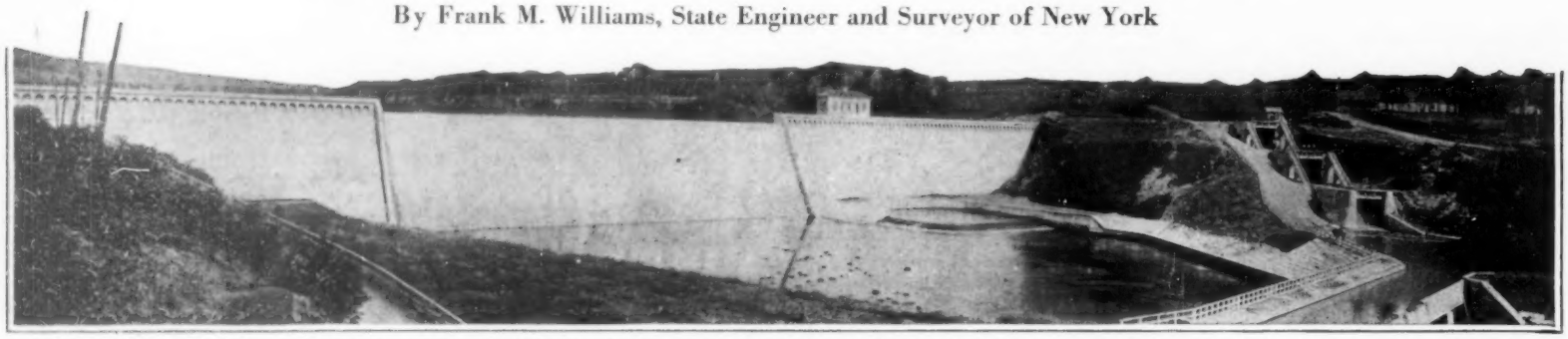


Covered building ways with four of our new S-type, 854-ton submarines on the ways

The New York State Barge Canal—II

Some Details of the Engineering Problems and the Way They Were Met

By Frank M. Williams, State Engineer and Surveyor of New York



The Delta Dam which impounds 2,750,000,000 cubic feet of water in a natural basin in which once stood the village of Delta. The reservoir covers 4½ square miles and is one of several such structures along the canal

ONE of the greatest problems involved in the construction of the Barge Canal was that of obtaining sufficient water to provide for the minimum depth at all times. That portion of the Erie branch extending eastward to Three River Point is mainly supplied by water from the Niagara River, supplemented by additional supplies from the Finger Lakes tributary to the Seneca River. The summit level at Rome is supplied from two existing reservoirs, as well as several stream diversions south of the Erie Canal between Syracuse and Rome and from two storage reservoirs located on the Mohawk River at Delta and on West Canada Creek at Hinckley. Water from the latter reservoir is carried down West Canada Creek for a few miles and then by a new open channel across a divide into Nine Mile Creek, a tributary of the Rome summit level.

The storage reservoir at Delta was formed by building a concrete dam about 1,000 feet long across the valley of the Mohawk River. This dam has a maximum height of 100 feet, floods an area of 4½ square miles and provides for the storage of 2,750,000,000 cubic feet of water, which is impounded in a natural basin where the village of Delta was once located. The Hinckley Reservoir consists of an earthen embankment covering a masonry core wall and is formed by a dam 3,700 feet long. It floods an area of 4½ square miles and has a storage capacity of 3,445,800,000 cubic feet of water.

The summit level of the Champlain Canal at Fort Edward is supplied from an existing feeder taking water from the Hudson River at Glens Falls. A portion of the water supply to the summit level passes northward to Lake Champlain, and the remainder southward to a point where the Hudson River has been canalized. The Cayuga-Seneca branch is fed entirely from the two lakes from which its name is derived, while the Oswego follows the Oswego River which has sufficient water for canal purposes.

In constructing the waterway about 100,000,000 cubic yards of material had to be excavated, approximately 10 per cent of this being rock. This work called for the use of a great variety of machinery and demanded some highly perfected types of excavators and dredges. About 3,000,000 cubic yards of concrete was placed.

The Locks

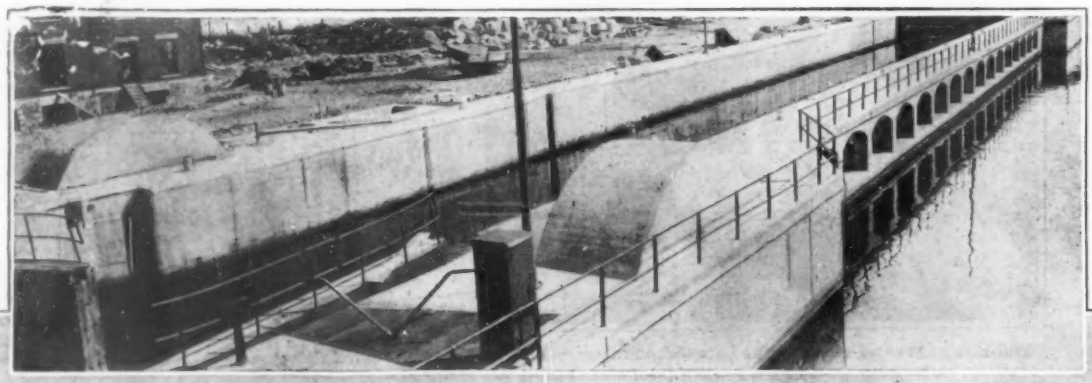
There are fifty-seven locks in the Barge Canal. These all have inside rectangular dimensions of 45 by 310 feet, the usable length of each being at least 300 feet and the usuable width 44.4 feet. All of these structures are built of concrete, the side walls being from 5 to 7 feet wide at the top and varying in height and bottom width with the lift of the lock and other conditions. In some cases, where one side of the lock is exposed to a river channel the top width has been increased to 12 feet. The bottom width of the walls ranges from 13 to 34 feet and is determined by the height of the walls, nature of the foundation, and certain incidentals in design.

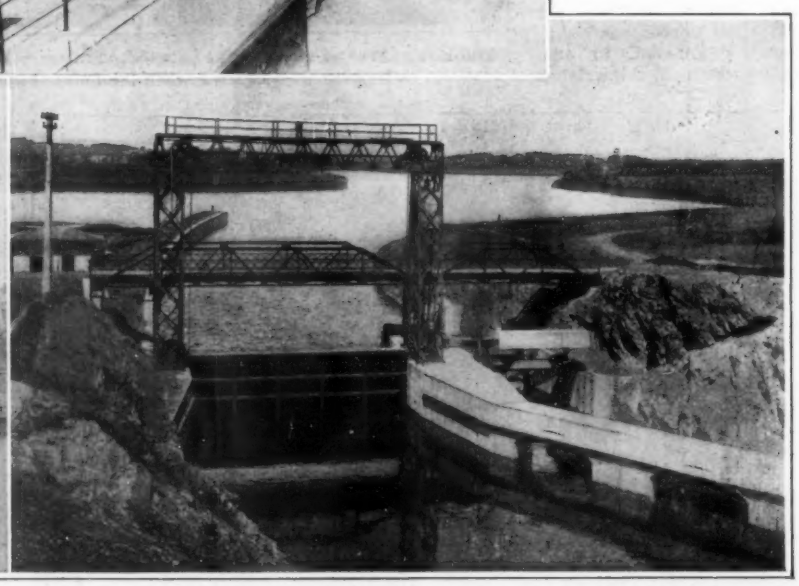
The chambers are filled and emptied through ports connecting with conduits extending lengthwise through the locks side walls. The flow is generally controlled by vertical lift valves, the exception being at Oswego where the chamber is filled and emptied by siphons.

Nearly all lock gates are constructed of steel and are of the mitering, girder type, the exception to this latter being the lower gate of the lock at Little Falls, which is of the solid lift type similar to the type employed as guard gates. In all cases, however, the minimum depth of water over the miter sills is 12 feet.

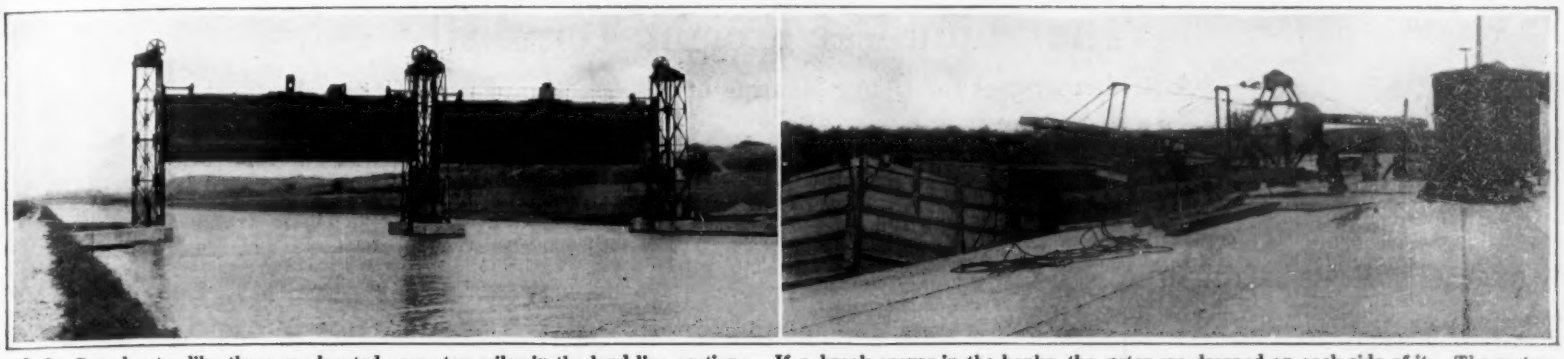
All locks are operated and lighted by electricity. Most of the locks have been provided with hydraulic turbines and the electricity used in operating and lighting is generated at the lock. In some localities power plants have been built which furnish electricity to several locks within a radius of a few miles while, in the Mohawk Valley the locks and movable dams are operated by electricity generated by gasoline motor sets, water power not being available.

The largest lock on the canal is at Little Falls and this structure has a lift of 40½ feet being one of the highest locks in the world. The most interesting locks are the five massive structures comprising the Waterford Series at the eastern terminus of the Erie Canal. These have a





Left: **Handsome highway bridge over the canalized Mohawk river at Amsterdam.** ***Right:*** **Guard gates at the head of Waterford locks, where they lead into Lake Crescent.** ***Top:*** **Siphon Lock at Oswego, with a lift of 25 feet. The largest siphon lock in existence and the first to be built in the United States**



Left: **Guard gates like these are located every ten miles in the land line sections. If a break occurs in the banks, the gates are dropped on each side of it. The water in the 10-mile stretch is diverted to by-passes, and repairs can be made.** ***Right:*** **Portable package freight conveyor, installed on the Schenectady Barge Canal Terminal for transfer of package freight**

combined lift of 169 feet and constitute the world's greatest series of high lift locks. Another interesting and unique lock is located at Oswego. This structure has a lift of 25 feet and utilizes the siphon principle in its operation, being the largest lock of its kind ever constructed and the first to be built in this country.

The Dams

For fixed dams a gravity type either straight or curved, with a rounded downstream face, has been used. The height of these dams varies from 6 feet at the Coughdenoy dam on the Oneida River to 100 feet for the reservoir dam at Delta.

Movable dams have been used wherever necessary to reduce damage from floods and ten of these structures are located tween Schenectady and Utica in the Mohawk River. Several general types of movable dams are used, the principal one being the bridge type and another being made up of Taintor gates. The Taintor gates when in use rest upon a sill crossing the bed of the stream and are opened

(*Continued on page 51*)

Tabloid History of American Merchant Marine

IN a special study made by the United States Shipping Board, it was found that 293 steamers under the American flag left American ports during the month of June, carrying a total of 1,177,444 tons of exports. Of this number 243 steamed from Atlantic ports, 33 from Gulf ports and 17 from Pacific ports. The value of the exports carried by these vessels in the one month was $268,228,502, or more than 50 per cent greater than in the entire year 1914, when the total value of American exports carried in American bottoms was only $166,055,081.

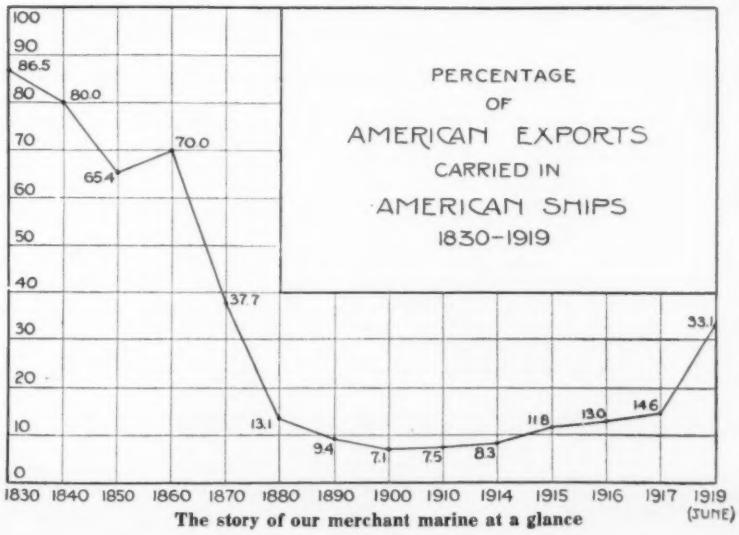
The Shipping Board drew attention to the fact that the percentage of American shipments carried in foreign vessels in 1914 was 91.8% of the entire export trade for that year. This compares with 66.9% for the month of June of this year, when $540,424,846 in exports were carried in ships flying foreign flags. Even as recently as 1917, more than 85% of our foreign going commerce was carried in foreign owned vessels. The gain in two years, from only 14.6% in 1917 to 33.1% in 1919, is the most striking evidence of the power of the new American Merchant Marine.

The diagram traces the percentage of exports carried in American bottoms over a period of about 90 years, beginning with 1830, at which time our own ships were taking care of more than 85% of our exports. With the exception of one point on the curve, that for 1860, a steady decline is shown in the percentage carried in American ships, from 1830 until the close of the last century. The partial recovery from that date until 1914, when the great war tie-up of ships forced us to depend more upon our own resources, was so slight that the present movement along the line of heavier use of American ships is all the more gratifying.

As the program of the Shipping Board progresses further and further towards final completion, and the ships available for American commerce increase to a much greater volume than those at present in use, we may confidently expect to see the percentage of American exports carried in American ships increase with the fleet of ships, until it reaches what may be considered a normal ratio of about half our total export trade.

The foreign-going steam merchant fleet of the United States on June 30, 1914, was about 4.3% of the world's tonnage of vessels of 1,600 tons and over. At the end of 1918 our percentage had gone up to 16.5, or approximately one-sixth the total. The tonnage actually under construction in the United States in 1918 was half that of the entire world; and the latest Lloyd's report shows about the same situation, with British construction less than two-thirds as heavy as ours.

It seems fair to assume that by the end of the current year American foreign-going tonnage will be close to 30 per cent of the total world's tonnage, for the Shipping Board announced, in mid-September, that the steamships under the American flag now comprise 24.8 per cent of the world's steam tonnage, and that 1,107 of the 1,280 vessels had been built by the Board within the last two years. With this as a basis, it ought to be relatively simple, barring congressional handicaps, to maintain our own position in the commercial field, and carry at least half of our own products as well as half the products shipped to us from foreign lands.—*Sidney Graves Koon, M.M.E.*



The story of our merchant marine at a glance

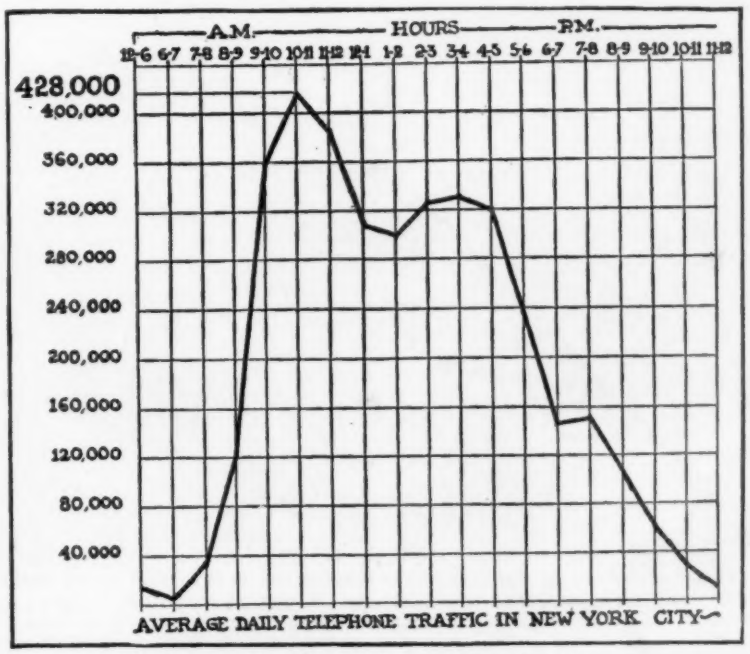
A Day's Telephone Calls

WHEN do you use the telephone most often? At what hour does the report "Busy" come back with the greatest persistence? What are the times of day at which you have to wait longest for a connection—presumably because all the trunk lines out of your central office are for the moment carrying a full load? The answer to these questions is carried on the chart herewith, prepared by the New York Telephone Company as a suggestion to its subscribers for their coöperation in the improvement of the service.

This chart represents the telephone business of the average day. From midnight to 6 A. M. it is small and getting smaller; then as the retail stores and other "early" businesses begin to shake off their slumbers it starts to mount. As offices open and clear for the day's action the rate of increase gets faster and faster, until in the one hour between 9 and 10 the calls are three times as numerous as during the 60 minutes immediately preceding. As the day's business gets into full swing, with everybody at work, calls continue to increase, though at a much less alarming pace; and the peak-load for the day is carried by the hour between 10 and 11, with 428,000 calls in the city. After 11 o'clock it appears that the impending lunch hour makes a certain number of telephone users feel that what calls they still have to make will best go over until afternonon; and from 12 to 2, while the city is eating, there is a still further drop—though 300,000 calls per hour during lunch time is a pretty respectable total after all.

When we return from our mid-day meal we do not run the wire business up to such a sharp peak as we did in the morning, when the urgent calls of the day were being made. The afternoon load is fairly constant from 2 to 5. Then it falls rapidly, however, and with the exception of the hour from 7 to 8, when people call up their friends to arrange for the evening's entertainment, there is a steady and rapid decline to the irreducible minimum of the next daybreak.

Individual days of course show peculiarities, which it is the business of one division of the company's engineering department to account for. When a single transportation line breaks down late in the afternoon there is frequently a peak rivalling that of 11 A. M., caused by the desperate efforts of all Staten Island or Flatbush or the Bronx to inform its family that it will not be home to dinner, and why. When the fake armistice story broke upon New York in November, 1918, just as the morning peak-load was being passed, everybody who could get access to an instrument tried to telephone home that the war was over, and the wires were literally swamped.



The course of New York's telephone traffic for 24 hours

The Shunt-less Freight Terminal

A British Project for Better Hauling of "Goods" in a Large City

UNLESS one has followed the vicissitudes of railroad shipments with some closeness, it is probably not realized what a vast amount of lost motion there is in the average freight terminal. Our contemporary, *Illustrated London News*, puts the matter very well in the following vigorous presentation, which we quote directly save for the substitution of current American expressions for those in use on the other side.

"The cars are made up into a train, and hauled to London by a locomotive—the one stage of the journey that is comparatively cheap and quick. Arrived at a main freight station, the trucks are shunted and assorted—that is to say, they are uncoupled and banged about over long stretches of rails to reach a position a few yards off. Formed into new trains, they are then hauled to another of the 74 freight stations that sprawl over London. Then the banging about sidings is resumed, till the cars are ranged (after such delays that the average time consumed in shifting a car of freight through the city from one railroad to another averages from ten to fourteen days) along one side of a platform, and the contents transferred to a row of carts and vans on the other side by an army of porters with small hand trucks. The carts go off, often but partly laden, to stroll about the city at rates from two miles per hour and upwards—the slowest vehicles setting the pace for all street traffic; after long waits they return empty. That is the present system; and if it were not a familiar fact, we should think it an incredible nightmare."

An English engineer, Mr. A. W. Gattie, has put forward a scheme for the better terminalization of railroad freight, through which he is confident that he can eliminate all the delays and lost motion involved in the present disorderly methods of dealing with the cars and their contents. He has worked it out in full detail as it would be applied in London, and as this shows its details much better than a general discussion could possibly show them, we shall follow him here rather than attempt any general description of his methods.

In the first place, Mr. Gattie tells us that in London there are 74 freight stations, and that of the 1,000 freight trains that pass over the metropolitan rails each day, no less than 750 are engaged solely in switching operations—in taking loaded cars from incoming trains or terminals to other terminals or outgoing yards. Only 250 trains are actually engaged in bringing freight into the city and taking it out; the other 75 per cent are merely adding to the congestion of the rails and of the payrolls.

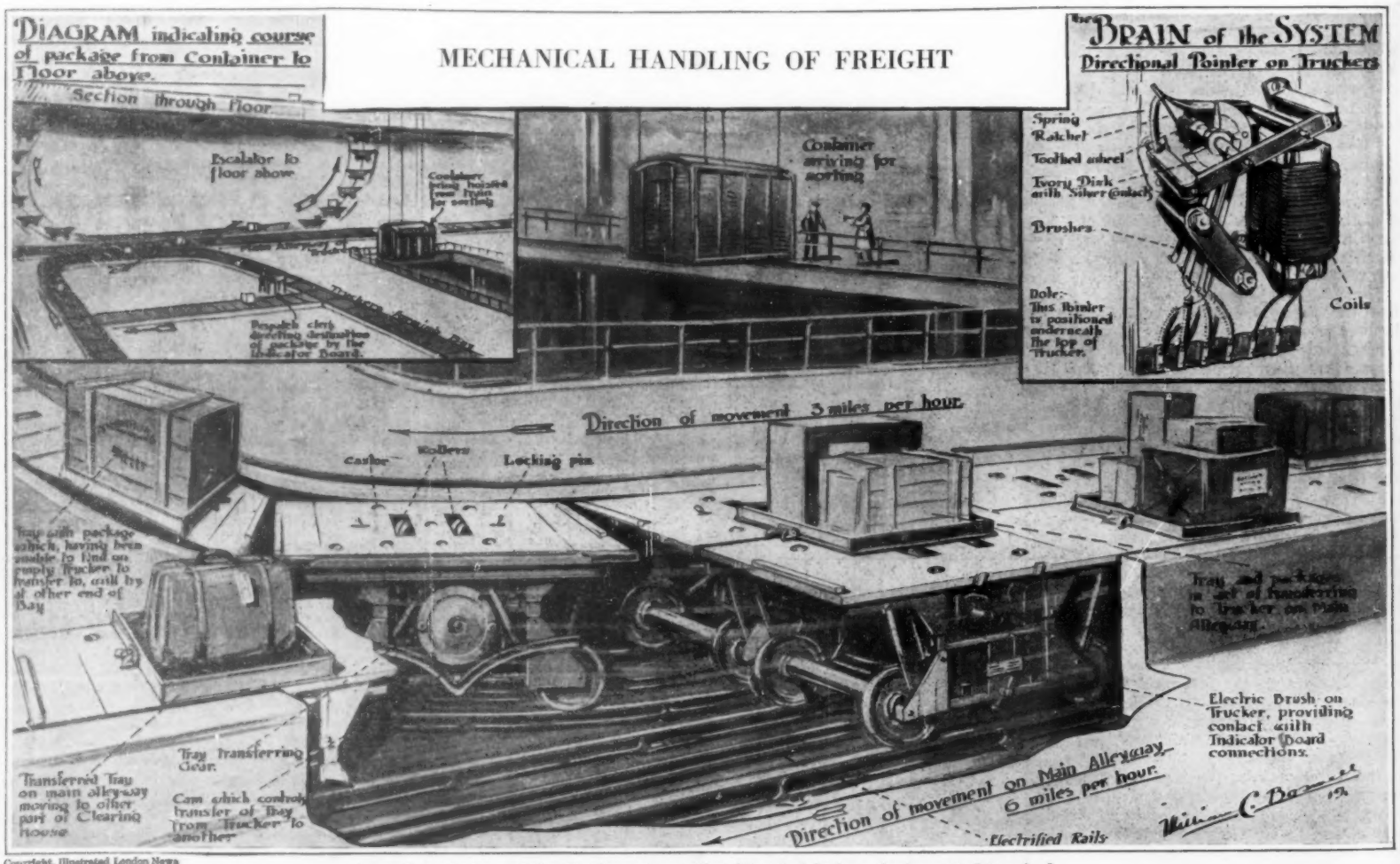
Mr. Gattie proposes to abolish the 74 stations which give rise to this waste of engine mileage, and to have a single central station. This would be, so far as the railroads are concerned, the clearing house for all freight. It is designed with a careful eye to all the details of handling and transferring freight; but so far as our present interest is concerned, we need pay attention only to one phase of the matter.

THE feature of present freight-handling methods which has received the greatest attention is the delay to which trucking is subjected in the streets. Of course this must eventually be remedied; but at the same time, we need not be blind to the fact that the railroads themselves delay freight inordinately every time it passes through a big city where delivery or transshipment is necessary. A British engineer puts out a scheme for eliminating the switching engine with its high cost and great delays; and everybody of authority who has looked into it is prepared to guarantee that it would work. In the present article we tell just what it is proposed to do with the freight traffic of London under the (hypothetical) installation of this system.—THE EDITOR.

The real secret of the system is what the designer calls the electric trucker, supplemented by containers and a fleet of 5,000 motor trucks. Large containers accommodating from two to five tons would be lowered into the railroad cars at original shipping points, and on arriving at their destination would be lifted from the cars by a crane and placed on the motor truck chassis without breaking bulk. For smaller articles and parcels there would be smaller containers. These would be placed on the different conveyors or truckers and carried to the sorting floor, whence they would be delivered to their proper places in the clearing house.

The old way of handling freight is really to be compared only with an effort to handle mail without the mail sack. The man who invented the mail sack—or rather the man who was responsible for its continued use after the advent of the railroad car—realized that the natural unit, consisting of letters with a common destination, was less than a carload lot, and that it could not economically be handled on the basis of a carload lot; and that at the same time this natural unit was greater than a single letter, and could not economically be handled as though it were a single letter. But in the handling of freight, we have never had a standard unit coming between the single piece and the carload lot; and the system has suffered accordingly. By giving us such a unit, Mr. Gattie tries to do for the handling of freight what the mail pouch

(Continued on page 51)


MECHANICAL HANDLING OF FREIGHT
DIAGRAM indicating course of package from Container to Floor above.
Section through Floor.
Escalator to floor above
Container arriving for sorting
Despatch clerk directing destination of package by the Indicator Board.
The BRAIN of the SYSTEM
Directional Pointer on Truckers
Spring
Ratchet
Toothed wheel
Ivory Disk with Silver Contacts
Brushes
Coils
Direction of movement 3 miles per hour
Castor
Rollers
Locking pin
Tray with package which, having been unable to find an empty Trucker to transfer to, will by at other end of Bay
Tray transferring Clear.
Transferred Tray on main alleyway moving to other part of Clearing house
Cam which controls transfer of Bay from Trucker to another
Electric Brush on Trucker, providing contact with Indicator Board connections.
Direction of movement on Main Alleyway 6 miles per hour.
Electrified Rails

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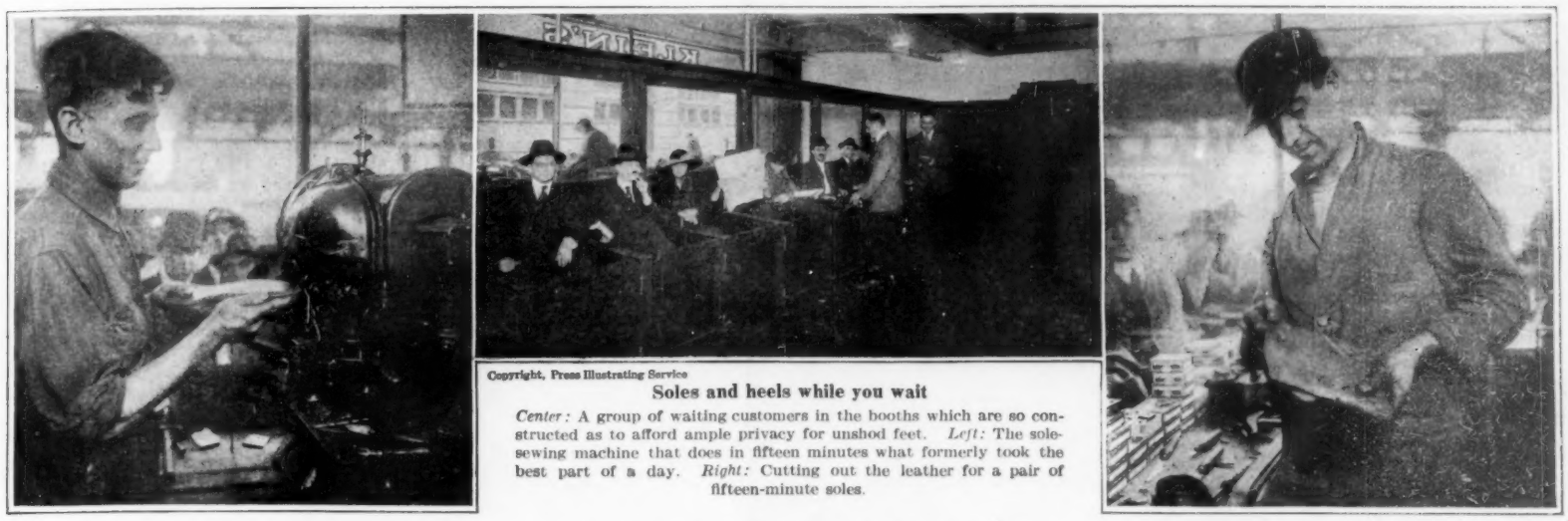
A number of views of the Gattie system of handling freight in a single central terminal

A container arrives at the clearing house, for the sorting and despatch of its packages to various destinations (*center, above*). Each package is forwarded by simple manipulation of an electric keyboard, via the truckers, to its proper despatch point on the same floor, or by escalators to another floor (*top, left*). Each trucker is fitted with controllers set to insure that the goods be ejected at their destination (*top, right*). The lower drawing shows a junction, where goods, passing from right to left of the picture, are automatically passed from one trucker to another during the journey from the sorting-bay to their final destination in the terminal



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Soles and heels while you wait

Center: A group of waiting customers in the booths which are so constructed as to afford ample privacy for unshod feet. *Left:* The sole-sewing machine that does in fifteen minutes what formerly took the best part of a day. *Right:* Cutting out the leather for a pair of fifteen-minute soles.

The Shoe Cafeteria

WE are accustomed to drop into the shoemakers for some minor repair like the sewing up of a ripped seam or the renewal of an eyelet, and expect that it will be performed while we wait; but for any such major operation as the attachment of a new sole or heel custom has always demanded that we leave our shoe and call for it the next day or the next week. This, in fact, was an obvious necessity in the days of hand work; but with the elaborate machinery now made for repairing shoes, without which even the smallest cobbler's shop is nowadays incomplete, the processes of shoe renovation have been so greatly speeded up that there really seems no good reason why we cannot get any repair made while we wait.

As a matter of fact, we can do just this—if we happen to know where to find the shop that specializes in that sort of thing. We walk in, select one of the little booths that is unoccupied, remove the shoe in question, and place it where one of the attendants will see it and recognize us as not yet having been waited on. He comes, gets his instructions, and hustles the shoe off to the part of the shop where the machines are located. Within fifteen minutes he is usually back with the job finished and ready to be worn away.

The repair of shoes while you wait is a convenience in more ways than one. When one of these shops is located in the vicinity, it never need be necessary to wear home or to the shoe-store a shoe that has broken down suddenly or as the result of accident. The second trip to the cobbler's to get the shoes that were left there day before yesterday, is eliminated in every case. To a good many people the fact that in these days of high prices it is no longer necessary to have a second pair of every-day shoes to wear while the first pair is being cobbled will mean that this ten or fifteen dollars of invested capital can be turned to better use. Also, with the quick-action repair shop around the corner, we will be freed from the tendency to let the crippled shoe deteriorate by wearing it longer than we should; we will take it to the hospital with the first signs of wear, and thus greatly prolong its life.

A Monster Among Gems

WHAT is believed to be the largest uncut gem in the world has come to light in a recently opened mining district in Nevada, where it was discovered in the spring of 1917. The stone is a "black opal," so called because dark tones predominate in it. It shows mostly dark peacock blues and emerald greens, with a considerable amount of red, and several less prominent shades.

In size this great gem approaches a quarter of an ordinary brick, being 3 15/16 inches in length, 3⅛ in width, and 2⅛ thick at the bulkiest point. Its weight is 18.6 avoirdupois ounces, which expressed in gem diction is 8,136 grains or 2,566.56 carats. More than a pound of opal is surely some stone! And it is all

An uncut opal one quarter the size of a brick

solid, uncracked, flawless gem material, free from matrix or adhering rock except for a paper-thin skin encrusting the two major surfaces. Little specks broken from this skin here and there reveal the brilliant play of colors within, while the exposed ends and edge exhibit the full refracting radiance of the mass.

This stone is about half again as large as the largest of the noted gems of the world. The Cullinan diamond was roughly the size and shape of a small fist, and, if it had been an opal, would have weighed but 1,729 carats. It is compared with the new opal on this basis since the specific gravity of the diamond is 75 per cent greater than that of the opal.—*Archie Rice.*

Making a New Nation

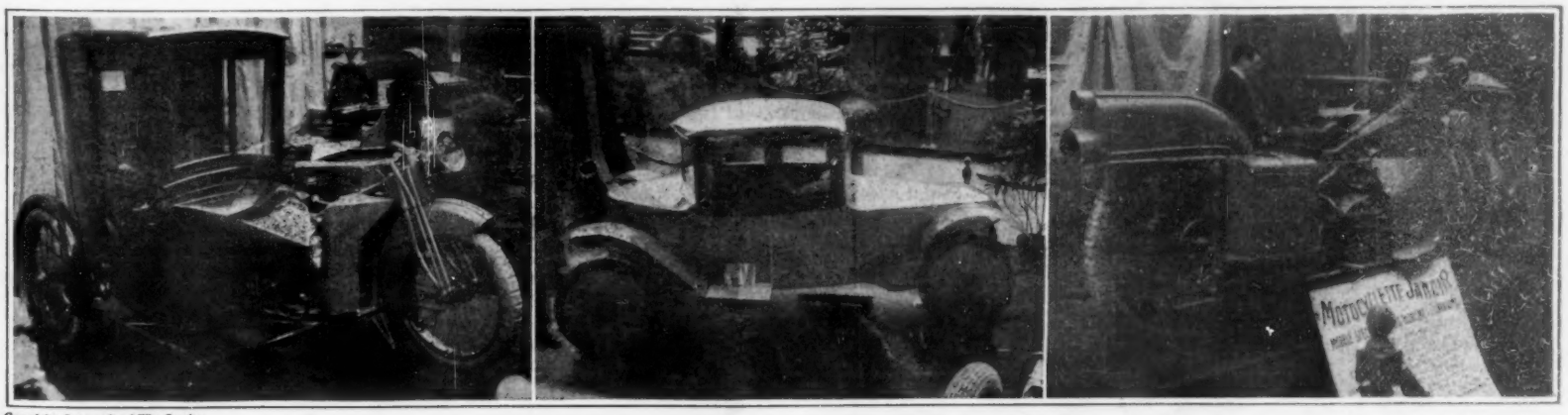
WITH the framing of the peace treaty Poland has received universal recognition as an independent State, though the eastern boundaries are still unsettled and a constant irregular warfare is being kept up with the Ukraine and Bolshevist Russia. The problem now confronting the Polish Government of restoring Polish industries and rebuilding the devasted areas is a very serious one. The country has 5,000 miles of railways but only a few cars or locomotives. An order for 150 locomotives has recently been placed in this country. Large purchases for shoes, clothing, textiles, and manufactures are being made in France and Great Britain, both by the Polish Government and private firms, the rate of exchange making it more advantageous for the Poles to buy in these markets than in the United States.

The Overgrown Motorcycle of Europe

JUDGING from accounts of the exhibits at the London and Paris automobile shows, it appears that the trend of European automotive practice is largely toward the development of the heavier motorcycle and the light automobile. In fact, at the London show there were a large number of motorcycles exhibited, many of them of the lightest possible construction, and again as many of the heaviest kind.

The three accompanying illustrations are of particular interest because they illustrate the trend of European motorcycle practice. One of these shows a heavy motorcycle with closed-body side car of Louis XV model, which was one of the leading attractions at the Paris show. Another illustration shows the motorcycle of this interesting combination. This machine weighs 400 pounds and sells for 4,000 francs (about $800 at the normal rate of exchange). It will be noted that this motorcycle has regular automobile tires, big tool chest, three-speed gear, electric starting and lighting system, electric horn, foot rests, and, in a word, most of the features of the usual automobile.

The center illustration shows a typical "feather weight" car, of which type many were shown at the London and Paris shows. This particular model is an 8 horse-power, with the two front wheels placed close together. The front wheels are the tractors, instead of the rear wheels.



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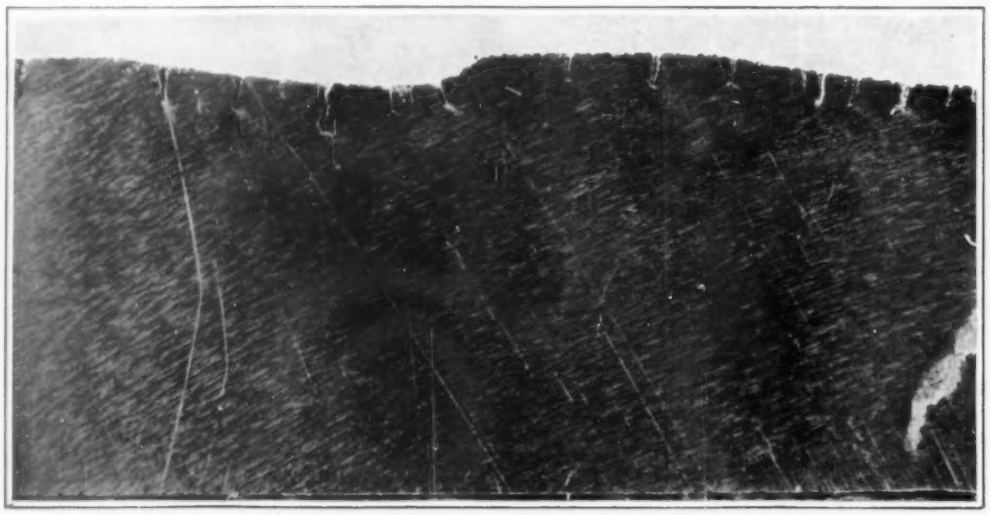
Motorcycle with closed side car of Louis XV model. An eight-horse-power closed car with the front wheels as tractors Motorcycle built along automobile lines, weighing 400 pounds.

Some features of European motorcycle and light car practice as exemplified by Paris automobile show exhibits

Why Big Guns Are Short-Lived

By Arthur Bennington

UNQUESTIONABLY, the most serious problem confronting the artillerist today is the rapid deterioration which takes place in the costly, heavy artillery, which plays such an important part in modern warfare, whether on sea or land. Twenty years ago a fairly accurate estimate of the cost of a gun of large caliber could be arrived at by allowing $1,000 per ton of the weight of the gun alone, exclusive of its mount. Today, in view of the great increase in the cost both of labor and materials, it cannot be less than $1,500 per ton, and in the large pieces may run even higher than that. For reasons which we shall consider later, the larger and therefore the more costly the gun, the shorter is its term of useful life. By useful life, we mean what the artillerist calls its "accuracy-life." When the accuracy is gone, it will be obvious that the usefulness of the gun is gone, also, for the elaborate calculations which are necessary to land a shell upon a target which may be from fifteen to thirty miles away, are based upon the assumption that the gun which fires it is in the same perfect mechanical condition as that in which it left the gun shop.

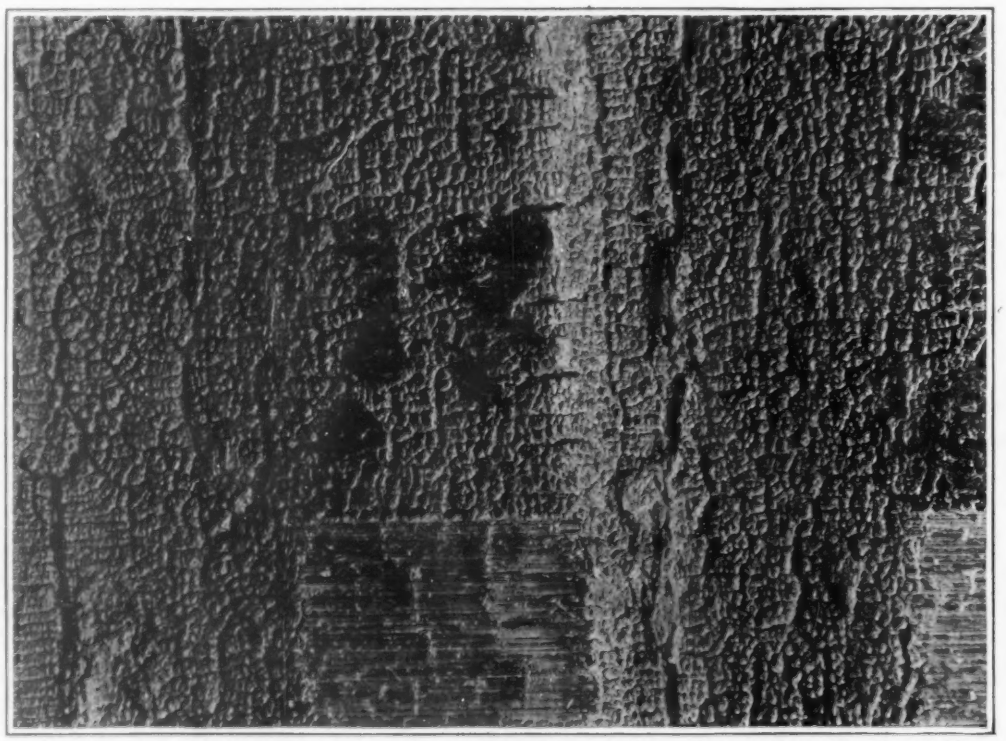


Transverse section of part of the rifling of a 12-inch gun, showing heat cracks

Experience has shown that, commencing with the very first discharge, there is a progressive deterioration of the carefully finished interior of the bore. This is so slight in the earlier rounds as to cause no serious variation in the range, but after a given number of rounds, dependent upon the caliber of the gun, have been fired, the interior becomes so badly worn down that the rifling ceases to give the speed of rotation to the projectile which is necessary to maintain its axis tangential to the line of flight. As the wearing out or erosion, as it is called, proceeds, the projectiles begin to wobble, in their flight, and when the erosion has proceeded to a certain point, the projectile will begin to tumble end over end. This erratic behavior of the projectile, of course, slows down its speed, and the question of hitting the target becomes very largely a matter of chance.

Many are the theories which have been advanced to explain the exact character of the chemical changes which take place in the metal of the bore and the mechanical forces which, coupled with the supposed chemical changes, combine to bring about erosion. In the current issue of the SCIENTIFIC AMERICAN MONTHLY is published a rather exhaustive review of the various theories which have been advanced by well-known artillerists to account for this destructive and extremely puzzling phenomenon. Thus, Rear Admiral Ettore Bravetta, of the Italian Navy, devotes a chapter of his recently published book on artillery to this subject under the title "The Life and Death of a Gun," in which he gives some striking figures showing that before the war, the British had established a scale, showing when the average gun of the various calibers had been eroded to the point of uselessness. Thus, they estimated that the one hundred millimeter gun had become inaccurate to the point of uselessness after 739 shots; the one-twenty-seven millimeter gun after 640; the one-fifty-two millimeter after 395; the three-hundred-and-five millimeter gun after 149 shots; the 343 millimeter after 102 shots, and the 406 millimeter after 83 shots. The life of the smaller guns is very much longer, varying from 4,000 to 7,500 shots. In the late war, we believe that some of the guns using nitrocellulose powder greatly exceeded even these last figures.

Among the theories which have been advanced to explain erosion, is that adopted by Admiral Bravetta. Briefly stated, it is as follows: The gun, in firing, absorbs a certain amount of heat which penetrates a very thin layer on the surface of the bore. The layer expands, but as it is surrounded by the thick, cold wall of the inner tube, the effort of expansion is restrained, the elastic limit is exceeded, and permanent distortion follows. Then, as the high pressure and temperature of the gases cease to be exerted, the thin layer contracts and, having been already crushed, its contraction produces a number of little surface cracks. This process continues with every shot, and at each the cracks widen. At each subsequent discharge the hot powder gases rush through these cracks, and in so doing, enlarge them. As the work of destruction goes on, the inner surfaces become rough, the lands flatten out and become eaten away.



Greatly magnified photograph of rifling of 12-inch gun after 400 shots. Note heat cracks and general wearing down of the lands

An illuminating discussion of this problem is given in the report of General William Crozier, as Chief of the Bureau of Ordance, for 1913. It is based on a study of a badly-eroded gun from which five rings were cut at stated intervals from the breach to the muzzle. The rifling at the breach was found to be entirely worn away, while that at the muzzle was in a practically perfect condition. General Crozier draws attention to the theory that the surface of the bore may be hardened in a manner similar to the hardening of tool steel, being heated above the critical temperature and then cooled by the great mass of metal back of the layer, with resulting hardness. The surface would then be brittle and without any plasticity, and the friction of the projectile as it passed through the bore might easily produce incipient cracks which, in successive rounds, would develop in size and extent. General Crozier neither accepts nor rejects this theory, though he thinks the evidence is rather against than for it. He points out that to raise the metal to the required temperature would necessitate a number of rounds of firing, and since the body of the tube would be considerably heated by each successive round, the process would really be a hardening followed by a tempering process, giving a fairly soft metal. As a matter of fact, however, the surface is found to be actually glass hard.

The second method by which hardness may be produced is by a process similar to wire drawing commonly known as "cold work." Beilby has shown that a surface skin may be built up by mechanical movement. This surface gives unmistakable evidence of having passed through a state in which it must have possessed the mobility of a liquid. The surface layers retain their mobility only for a brief period and then solidify in a vitreous amorphous state. Such a surface, as produced by polishing, burnishing, drawing or hammering, possesses the property of hardness or brittleness.

The third method of producing hardness is by increasing the amount of carbon on the surface of the bore, as is done by the cementation process of hardening armor. It has been suggested that the hot powder gases act to produce this result on the bore. This theory best accounts for the fact that the hard layer is thickest in the firing chamber. General Crozier as the result of examination, microscopic and otherwise, of the interior surface of eroded guns, reaches the conclusion that the development of heat cracks is due to the presence of a hard surface produced by cementation of the metal by the products of combustion of the powder, and by work put upon the surface by the moving projectile. For a more detailed discussion of this problem the reader is referred to the article, published in the current issue of the SCIENTIFIC AMERICAN MONTHLY in which additional photographic illustrations are given of the eroded surfaces of an army 12-inch gun that had been fired 239 rounds.

A Leather Substitute

A GERMAN manufacturer advertises driving belts and wide belts for conveyors, elevators and similar purposes, formed of braided steel wire. It is stated that these belts are protected on the running face with a covering of felted paper, which affords an adhesion equal to that of leather.

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The set of angle gages by means of which any desired angle can be built up

The Built-Up Angle Gage

SWEDISH and American inventors and tool-makers have made us fairly well acquainted with the built-up gage for the measurement of thickness, and we are no longer amazed to put together a half-inch block, a tenth-inch block and one of .1001 inch, and find that the group is, so far as we can tell, exactly .7001 inch thick. In fact, our system of quantity production has come to depend rather heavily upon this sort of built-up gage, and would be thrown into considerable confusion if it were forced to get along with less dependable methods of checking.

The original Swedish manufacturer of such gages has been aroused by recent efforts to duplicate and surpass his work right here in America, and is meeting the challenge by putting out gages of greater accuracy than anything he has ever claimed before, and at the same time by designing new types of measuring implements. In particular, he has taken a very bold step by applying the principle of the built-up gage to the measurement of angles.

It might at first glance appear that this is an absurd statement; angles hardly seem susceptible of being built up in the same way as thicknesses. Nevertheless, we illustrate a little box containing 85 thin steel blocks by means of which any desired angle can be constructed, the fineness of the system running down to a fraction of a minute.

As a matter of fact, the 85 blocks give the service which we could get out of 340 gage-blocks for a linear dimension. A block of the latter character has to be the same thickness all over, and hence can be used for the addition of but one, fixed amount to the pile already built up. But a rectangular angle-gage can have a different angle at each of its four corners, and this in fact is the way in which the ones which we illustrate are made up.

All these blocks have the two long sides exactly parallel down to within a certain distance of the end. From that point out, the side is cut away at an angle, the size of which is indicated on the face of the block. When two of the blocks are laid together, the parallel sides will "wring" together much as do the block gages with which we are acquainted; and then we need only slide one upon the other until the two points of angular divergence coincide. Having at-

(Continued on page 52)

A Smoke Mask Reduced to the Simplest Form

NOTHING in the way of a smoke mask could be simpler than the device shown in the accompanying illustrations. It consists of a canvas hood, with mica squares admitting light. This fits closely over the head and shoulders, and from it trails a hose which reaches down to the floor and through which air is carried up to the wearer. The principle employed in designing this mask is founded on the natural law that heat and its products rise, leaving a cushion of relatively pure air close to the floor. Stairs may be climbed by the wearer of this mask, owing to the fact that a cushion of air is formed on top of each step in the same manner as on the floor.

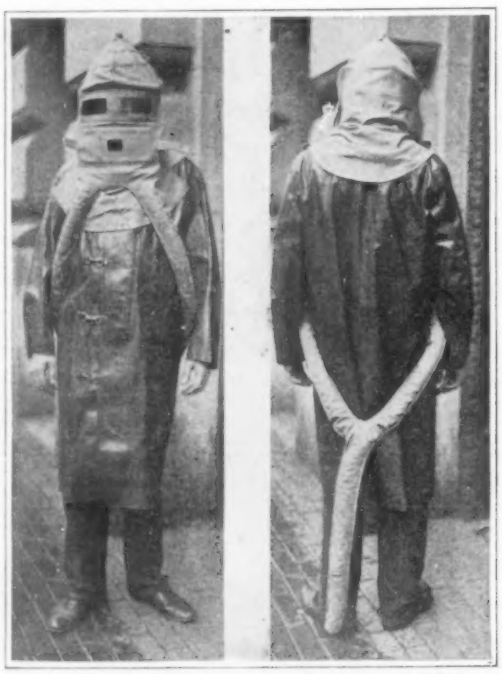
On account of its simplicity and the fact that it can be put on instantly by a woman or child, factories and department stores are installing them alongside fire extinguishers. The helmet weighs four pounds. It can be put on and adjusted in 15 seconds. No mechanism can get out of order, and there is nothing to forget in the excitement that generally accompanies a sudden emergency.

In a recent test of this simple smoke mask a fireman stayed 15 minutes in an airtight room filled with fumes from formaldehyde and burning rags—one of the severest tests known to firemen.

Deep Sea Suits and Diving Records

THERE appears to be no little rivalry of late in the matter of diving suits and deep sea diving records. And why not? Five years, more or less, of intense warfare directed against merchant shipping has paved the bottom of the ocean with many valuable cargoes which await the deep sea diver.

Recently John T. Turner of Philadelphia, Pa., a diver



Front and rear views of a simple smoke mask

Copyright, Underwood & Underwood

This diver recently descended 360 feet in this diving armor

of international repute, went down 360 feet and reached the bed of the ocean 15 miles east of Graves Light, near Boston, Mass. For this test he wore a diving suit invented by a colored mechanic, Charles H. Jackson, who is shown standing to the left of the diver, in the accompanying photograph. While this feat was proclaimed a world's record, a glance through our records discloses the interesting fact that it is still one foot less than a previous record.

In a demonstration in Grand Traverse Bay, Michigan, during October, 1916, B. F. Leavitt descended to a depth of 361 feet in a new diving armor of which he is the inventor, and remained under for 45 minutes. In the Leavitt suit the diver has little difficulty with the joints, and it is claimed that recent improvements have made it more or less proof from "freezing," or binding. A telephone in the helmet permits the diver to keep in constant communication with the men aboard the ship, and to direct their efforts, it being understood that the diver can do little physical work while at that depth and clad in such armor. His function is more one of directing operations carried on by machinery.

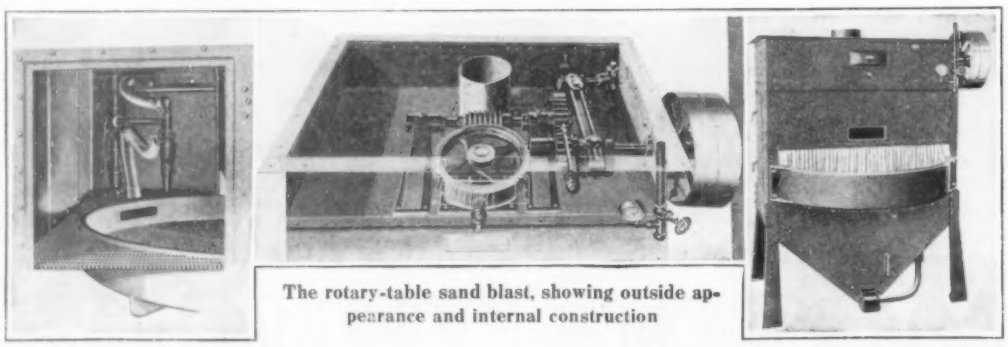
Both the Jackson and Leavitt diving suits have much in common, and it will be interesting to note how they are applied in actual salvaging operations.

A Rotary Table for the Sand Blast

THE demand is great for hygienic sand-blast equipment that protects the operator. So far as large shops are concerned, this demand is well met by several types of installation; but for the small shop producing a little work of limited size, there has been little aid offered by the blast manufacturers. An effort to remedy this deficiency is the automatic rotary blast table, illustrated herewith. This apparatus consists of a rotating table, half exposed and half in a dust-tight housing in which the blasting action is localized. Work to be cleaned by the blast is loaded on the visible half of the table, turned into the blast-chamber, and brought out for inspection as frequently as desired until it is finished. The blast itself is of the suction type, the spent abrasive falling through the grated top of the table and being returned to the blast in a continuous cycle.

The table top is provided with a rim four inches high, which acts as a retainer for light work, which otherwise might be dislodged or blown off by the force behind the blast and as it

(Continued on page 52)



The rotary-table sand blast, showing outside appearance and internal construction

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Mapping with the Squeeze of a Bulb

(*Continued from page 34*)

map is nearly double that which the engineer alone could cover.

The photographer is equipped of course, with a camera and all the necessary detached parts besides a plane-table board, an open-sight alidade, a compass, an aneroid barometer, and a notebook. He travels alone and carries a pack which weighs about thirty pounds. Besides taking the usual number of photographs at his station he takes half a dozen or more sights at other stations and prominent peaks, on frosted celluloid with the open-sight alidade on the small board. When he doubts that the photographs will show the shape of the mountain occupied he sketches a few contours close about it. Lastly he indicates briefly those portions of the area within a radius of ten miles which the photographs cover. The sights taken at his stations, though not essential in establishing the positions of the stations help the topographer in choosing stations for succeeding days. The degree of success which the photographer attains with his work depends on his aptitude as a mountaineer, topographic sense, hardiness, and ability to retain a correct mental picture of the country he sees. Experience in topographic surveying tends to develop all these qualities, and therefore such training is helpful to the photographer. Likewise, familiarity with cameras aids to a considerable degree, yet the manipulation of the panoramic camera in use today can be readily acquired by all who have a proper appreciation of the accuracy demanded in surveying instruments.

Cleaning One of the World's Largest Clocks

(*Continued from page 35*)

to ten tons, and chime the quarters upon eight smaller bells." It was decided that there should be only four bells for the chimes in addition to the great hour bell. The four bells were made and hung in the manner first designed; but the fifth was not so satisfactory. It was to have been nine feet in diameter, nine feet thick at the sound-bow, and to weigh 14 tons, or nearly three times the weight of the great bell at Saint Paul's Cathedral, its neighbor down in the "city" a couple of miles away. It was to have been struck by a hammer of a ton weight and was then to yield the note *E*, one octave lower than the *E* of the chimes, and forming a musical chord with the whole of them. It was cast in 1856, after weeks of preparation, and after being cast, turned and trimmed it weighed about 15 tons. It was carefully conveyed to London and placed at the foot of the clock-tower. It was struck every Saturday a certain number of blows to test the quality and loudness of the sound. On one occasion, the note was found to be of a dull and uncertain sound, and it was found that owing to a flaw in the metal, the bell was practically useless. There was great sorrow all over the country when it became known that "Big Ben was cracked." While the bell was to have been known officially as "Saint Stephen," the public dubbed it "Big Ben," and the name stuck. Another bell was cast and was finally raised to its place, but it cracked like the first. The lowest or deepest of the four chimes or quarter-bells was thenceforward used as the hour-bell.—*A. A. Hopkins.*

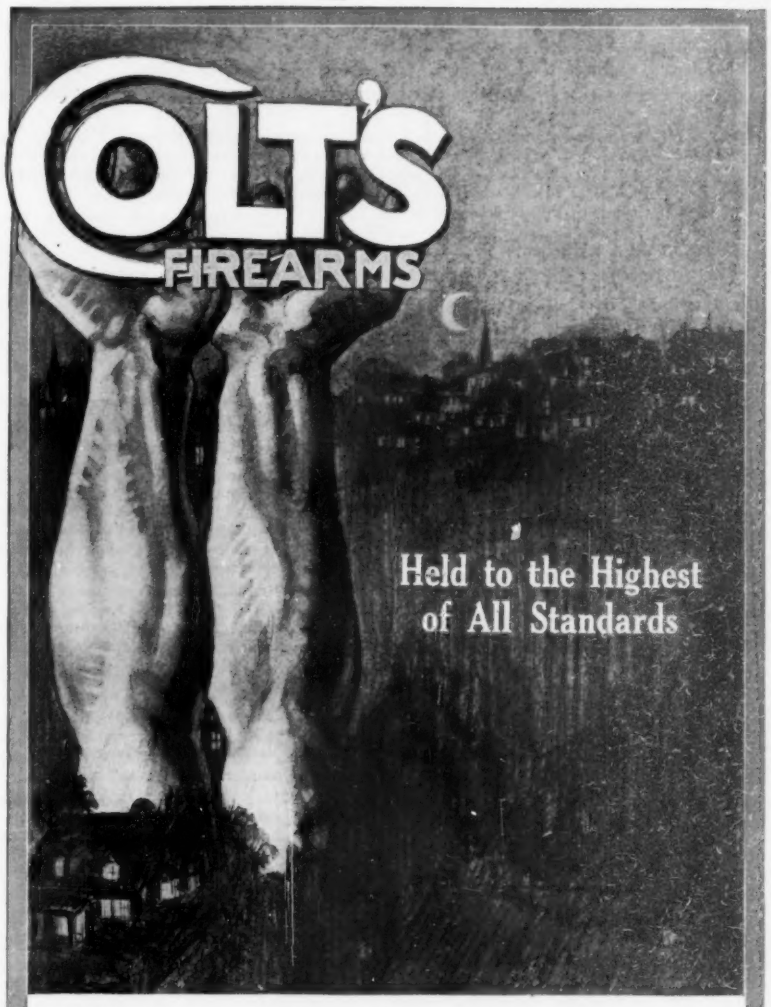
Revival of Our Oldest Navy Yard

(*Continued from page 39*)

shiphouse was built the frigate "Congress" which, it will be remembered, was burned in Hampton Roads in action with the Confederate Ironclad "Merrimac." The yard took its share in the building of our steam frigate Navy, and set afloat the "Santee" and the "Mohican."

But next to Paul Jones' "Ranger," the most notable ship to be built at Ports-

(*Continued on page 50*)



Master Craftsmanship

NO handiwork of man possesses a finer degree of mechanical exactness, a nicer precision of working parts, a more compact strength than the creation of the master gunsmith —

And to have maintained unquestioned leadership for over eighty years—keeping step with every advance of an inventive age—is the return made by the great *Colt* factories to a trust imposed by Government request. Since its adoption in 1911 the *Colt* Automatic Pistol, caliber .45, has been the official side arm of our Army, Navy and Marine Corps and with them did its "bit" overseas.

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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

FIREPROOFING FOR AIRCRAFT.—P. R. BRADLEY, address Aircraft Fireproofing Corp., 120 Broadway, New York, N. Y. This invention relates to the fireproofing of the cloth and wooden parts of flying machines by the application of a varnish-like liquid which imparts a fire-resisting surface, thereto, the fireproofing being made of alginic acid products or an alginate as a basis. The general object is to provide a fireproofing which can be easily applied and is comparatively inexpensive.

LAMP CORD ADJUSTING CLAMP.—D. F. MORIARTY, South Meriden, Conn. The invention more particularly relates to an adjusting clamp applicable to incandescent lamp cords for shortening or lengthening the cord and obviating the necessity of tying knots or otherwise damaging it. The purpose is to provide a simple form of adjusting button, comprising two separable clamping members held together by a screw and fitted with a yieldable spring means to prevent damage to the cord when the clamp is adjusted.

FLASH LIGHT.—H. H. HUTCHINGS, 356 Highland Ave., Arlington, N. J. The general object of the invention is to provide means for preventing the weight of the battery from acting on the central contact of the lamp bulb and breaking the bulb loose from the screw base of the lamp, damaging the filament or breaking the cement of the central contact. A more specific object is to provide means to support the weight of the battery when the flashlight is invented.

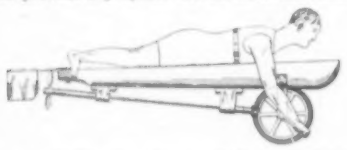
Of General Interest

COMBINED PRINTING, ENLARGING AND DIMINISHING APPARATUS FOR PHOTOGRAPHIC USE.—J. P. HANSEN, Copenhagan, Denmark. This invention concerns an apparatus for enlarging on sensitive paper, the object being to save considerable floor-area in photographic dark rooms, where space is usually somewhat limited. When printing and enlarging a vertical position of the negative is often adapted: this involves certain difficulties, as the arrangement requires a horizontal position of the enlarger and the stand for the sensitive paper; by the present invention much space can be saved by the use of a vertical stand.

SCRAPER.—S. C. FREDSON, 320 State St., Savannah, Ga. The invention has for its object to provide a device wherein the bail, body and handles are so connected that the body may be dumped by traction on the bail and wherein the handles are provided with means for holding the scraper in loading position.

MARCEL WAVER.—A. SCHARER, 2341 Broadway, New York, N. Y. Among the objects which the invention has in view are to provide means for waving the hair without heating the same, to provide a device for accomplishing the above purpose which is simple in form, and easily cleansed and maintained sanitary, and to supply means for retaining the wave produced in the hair, the parts of the device being so constructed as to yield to prevent breakage when accommodating various thicknesses of hair.

MAN POWER BOAT.—J. G. WILSON, Ellendale, Del. The invention relates to a manually operated power boat, one of the principal objects is to provide a propeller driven boat on which a



A SIDE ELEVATION OF A BOAT CONSTRUCTED ACCORDING TO THE INVENTION

man may be supported in the water, hand operated crank means being provided by which the swimmer may readily propel himself about, and foot operating means for controlling the rudder.

PENCIL.—W. K. HOLMES, 409 Pearl St. Brooklyn, N. Y. More particularly the invention relates to pencils of the type in which the lead is projected from and retracted into a pencil barrel. The primary object of the invention is to provide a device in which the several parts which serve to make up an operative structure may be readily and easily assembled.

REINFORCED BUILDING WALL.—F. HEATH, National Realty Bldg., Tacoma, Wash. The invention relates more particularly to a building wall of the type described in Patent No. 1,215,149 granted to the same inventor February 6th, 1917, the prime object being the provision of a wall wherein reinforcing members may be utilized without changing or breaking the running joints of the blocks or tiles and without displacing or otherwise interfering with the alinement of the supporting webs.

COLLAR BUTTON.—J. W. BARGER, Danville, Ill. The invention has for its object to provide a construction to facilitate the insertion of the head of the button in the button-hole of a

PROFILE OF THE BUTTON

collar, and a neck band. To accomplish this result the thickness of the head of the collar-button is reduced to such an extent as to relieve the necessity of spreading the button hole, and to greatly reduce the friction in slipping the necktie along the button head.

SHADE ROLLER.—J. W. PRICE, Box 651, Henryetta, Okla. The invention has for its object to provide a simple roller wherein the operation of the spring which rotates the roller to wind up the shade is controlled by a pawl so mounted that it will always be in position to engage the catches of the roller, and which is positively held out of engagement with the catches when the roller is rotating above a predetermined speed, and which may be easily disengaged when desired to adjust the roller.

HAND PRINTING STAMP.—F. B. DAHL, Christiania, Norway. The invention has for its object a hand-printing stamp for stamping different inscriptions such as addresses on envelops, paper, etc. The main feature consists in the combination with a spring actuated vertically movable stamp, the lower end of which carries an inking pad, of a pattern band, provided with perforations corresponding to the several inscriptions, said pattern band being given a stepwise motion by each movement of the stamp.

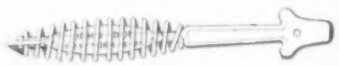
DISPLAY DEVICE.—S. MITTLEBURG, 257 W. Federal St., Youngstown, Pa. The invention has for its object to provide a display device having woven panels in the openings of which brackets may be mounted for displaying articles. Another object of the invention is to provide a form of bracket for use in connection with the woven panels.

TROUSERS HANGER AND PRESSER.—A. L. ANDREWS, Tonopah, Nev. The object of this invention is to provide a simple device of the character specified whereby the trousers may be pressed while hanging in a wardrobe or other place of storage, and wherein means is provided in connection with the hanger for permitting a coat to be hung upon the hanger.

FOUNTAIN PEN.—E. M. and W. A. HOUSTON, 406 Pierce St., Minneapolis, Minn. An object of the invention is to provide a fountain pen including a barrel having a plunger movable in the bore thereof to draw in a quantity of ink by suction, the bore of the barrel being enlarged near the point of the pen to form an expansion chamber into which the plunger is adapted to expand after the ink has been drawn in.

CIGARETTE CASE.—F. ROTH, 241 W. 23d St., New York, N. Y. The invention relates to a case for cigarettes, cigars, matches, etc., and more particularly to a two-part case designed and constructed to partly eject in sequence, one at a time, the cigarettes, cigars or matches, therein contained by sliding one part of the case over the other, which movement is effected by the thumb and index finger of one hand.

ADVERTISING DEVICE.—J. D. NOBLE, 36 Cottage St., Poughkeepsie, N. Y. The invention relates particularly to a device which can be used as a stove lid lifter, poker, or other implements requiring handles, in which the advertising matter



VIEW OF INVENTION AS APPLIED TO A STOVE LID LIFTER

is permanently displayed and is readily visible through the openings of the grip, and in which the advretising matter cannot be easily displaced or obliterated, and which adds comparatively little to the cost of the implement.

EAR TAG.—H. SPURLING, Taylorville, Ill. The principal object of the invention is to provide an extremely simple and durable ear tag or label, for marking animals, which will at all times expose the identification number or mark in plain view, and which will not irritate the animal and which will not become readily lost or torn out of place.

Hardware and Tools

EAR TAG TONGS.—H. SPURLING, Taylorville, Ill. The principal object of the invention is to provide a fastening tool for setting tags or labels in the ears of swine and the like. The invention resides particularly in providing a clamp which will hold the tag in position to engage the ear of the animal, and which will in one operation effect the piercing of the ear and the crimping of the prong about the eye of the tag, whereby to secure the tag in place on the ear.

PIPE INSULATION FORM AND CASE.—R. H. BLACK, 416 West Archer St., Tulsa, Okla. The invention relates to means for protecting the fittings on pipe lines where fittings require insulation and protection, it has for its object the provision of a separable case adapted to be engaged upon the ends of pipe coverings adjacent a fitting, this case being adapted to be filled with, and serve as a mold for an insulating material, such as a paste formed of asbestos and water, the case being removable if desired.

GATE LATCH.—B. F. WRIGHT, Fort Branch, Ind. The purpose of this invention is to provide a latch suitable for use upon gates and doors, more particularly to provide a latch which can be made up easily of metal bars, and so constructed that when used upon a gate, said gate may be raised up for a distance of several inches without interfering with the security of the latch. This is particularly important where cattle are in the habit of slightly lifting the gate in an effort to open it.

SPOOL HOLDER.—A. J. KAHN, 27 E. 22d St., New York, N. Y. Among the objects of the invention are to provide a spool for thread, so that the thread may be conveniently handled without becoming entangled. The spindle includes an ornamental head, a clamping device for applying the holder to a supporting member, and felt washers to prevent the marring of furniture to which it may be applied.

Heating and Lighting

HEATER.—B. C. SKINNER, Dunedin, Fla. The object of the invention is to provide a heater more especially designed for use in groves growing citrus fruit, the device is arranged to insure lateral radiation of a large amount of heat from a point close to the ground. Another object is to permit of burning coke as a fuel to insure a red heat of the entire metallic shell. Another object is to permit of readily shipping or storing the heater in a knock-down condition.

HEATING UNIT.—J. PHILIPPI, 1235 Second Ave., New York, N. Y. The invention relates particularly to a heating unit forming an attachment to the heating system of a house. An object is to provide a number of separate heating units of comparatively small capacity placed in different parts of the cellar of a building so as to provide the steam at the point desired. The invention provides a heating unit which is connected to and directly below each riser and may be used in connection with the furnace or independently.

BOILER COUPLING.—J. J. MCCANN, 4518 Ashland Ave., Norwood, Ohio. The invention has for its object to provide a simple and efficient coupling which normally closes the inlet, but it may be easily lifted under pressure to permit the entrance of water to the boiler. The valve, however, absolutely prevents regurgitation from the boiler into the water main.

Machines and Mechanical Devices

CORE PULLING MACHINE.—F. L. A. STINDT, Tuckahoe, N. Y. This invention relates to the manufacture of hollow rubber bodies such as are used in the manufacture of hot water bottles, douch bags and like articles, made hollow over a core and pressed exteriorly in dies. The object is to provide a core pulling machine arranged to enable the workman to readily and quickly remove the core from the hollow body after the latter is fashioned in the dies.

SHAFT BEARING.—P. H. KECK, 2718 Sheffield Ave., Chicago, Ill. The invention relates particularly to shaft bearings and the like, the object being to strengthen the same as well as to increase the life and length of service, by the insertion of a stabilizing and stiffening agent within the soft and unstable material of which bearings of the present nature are made. The invention is more particularly applied in the form of an insert embedded within the babbitt or other metal bearing.

SAFETY DEVICE FOR ACCUMULATORS.—R. H. ALDRICH, Allentown, Pa. The object of the invention is to provide a safety device for hydraulic accumulators arranged to relieve the pressure supply pipe from undue strain incident to the fluctuation in the pressure, and, in case the supply pipe should break or become leaky, to close the same and thereby prevent the accumulator from dropping. Another object is to permit of minute adjustment of the device while the accumulator is in service.

MACHINE FOR SHAPING PRINTING PLATES.—C. WINKLER, Berne, Switzerland. This shaping machine comprises a cutting tool and a plate carrier member provided with flat and curved plate supporting faces, said carrier being adapted to be turned to carry either plate to position to be operated on by the tool, the tool being horizontally disposed axially, and mounted to have horizontal movement perpendicular to the plate and parallel therewith.

FRUIT GRADING AND ASSORTING MACHINE.—B. C. SKINNER, Dunedin, Fla. The invention relates to fruit grading or assorting machines using a runway comprising cooperative parallel members, one of which consists of a series of rolls arranged end to end and disposed progressively at different distances from the other member to form communicating fruit discharging passages of progressively different widths along the runway. An object is to enable the user to quickly set the machine from one fruit to another.

REVERSIBLE TABLE FOR DRILL PRESSES.—H. P. EILERS, 2401 Tenth Ave., Los Angeles, Cal. The general object of the invention is to provide a work table with a plate which is removably fastened in place and can be reversed when the normal top face becomes worn, whereby the life of the work table is doubled. Another object is to provide a table which embodies an oil collection pan in which is mounted the work-carrying plate, the pan permitting a liberal supply of oil without waste.

FEED CARRIAGE FOR WARPING FRAMES.—T. HELLAWELL, 184 Lawrence Ave., Paterson, N. J. Among the principal objects of the invention are to provide means for delivering threads uniformly to a reel preparatory to the transfer therefrom to form warp drums for looms, to secure an even deposit of said threads, to provide means for facilitating the repair of threads when being delivered to the reel, and to regulate the spread of the reel section on entrance to and departure from the carriage.

SHAFT COUPLING.—E. F. WAGNER and G. H. LAWRENCE, 522 St. Ann St., Owensboro, Ky. This invention relates generally to couplings, and more particularly to shaft couplings, the object being the provision of a coupling acting by compression as well as one which will be simple, durable, readily applicable in and removable from, operative position, also one which will be effective and efficient.

PUMP.—G. E. HASZINGER, 206 21st St., Galveston, Texas. The object of the invention is the provision of a pump with a counterbalance for the weight of the column of liquid in the suction pipe provided by a vacuum chamber in the pump, and having a central axially arranged suction chamber at the center of the vacuum chamber, said suction chamber having a port in its bottom communicating with the vacuum chamber, and a valve cooperating with the port, said valve being normally held slightly open.

WINDMILL.—A. E. BROWN, 2205 Caples Bldg., El Paso, Texas. The invention has for its object to provide a windmill wherein the wheel operated by the wind current is arranged to rotate on a horizontal axis, and rotate about a vertical axis on the tower or support for the wheel, and wherein the blades or vanes of the wheel are connected thereto to move into inoperative position at the bottom of the wheel and into operative position at the top, and mounted to yield under excess pressure to prevent injury to the mill.

Musical Devices

PIANO AND PIANO PLAYER.—J. B. MCEWEN, London, England. This invention relates to devices of the type in which the movement for actuating a hammer used for striking a string of a musical instrument is modified between the original source and the point at which it is imparted to the hammer action. The object is to provide means for modifying the hard brilliant quality of tone produced by mechanical pianos and piano players, and obtain a full sympathetic quality of tone.

(*Continued on page 50*)

The Geographer's Corner

Facts and Figures from the World at Large and from the Explorer's Notebook

Edited by John Storck and Cyrus C. Adams of the American Geographical Society

Opening Africa.—Geographical exploration was practically dead during the war. In many African colonies, as the Belgian Congo, Senegal and others, thousands of natives were taken to Europe for service with the Allied armies. There was hard fighting between the British and Germans in each of the four German colonies and France took a share in it along the Guinea Coast. Even where the war was not carried into the tropical colonies of European States there was retrogression because they were neglected and at a standstill. Practically no exploration except in the polar regions was in progress in those four years.

We know now that in the rebuilding of the world, intensive study is to be given to the whole earth to ascertain how every part of it may add most efficiently to the things that people need. It is the purpose of this column to record the work planned, in progress or completed, to add to our knowledge of the world and its resources; and the means by which these resources are to be made widely available.

We now know practically what route will be followed by the Cape to Cairo R. R. from the south end of Africa to the Mediterranean. Before the war began the railroad from Cape Town had been completed to Broken Hill in northern Rhodesia and was then pushed on to Elizabethville, the city that had sprung up in the Katanga copper mining region near the southeastern edge of the Belgian Congo. Then the line was pushed northwest to the Lualaba, one of the great head streams of the Congo and it was expected to extend it north, also along the river, to Stanleyville, about 700 miles. Here one of the great problems would be met.

The railroad was to pass for 700 miles through the great tropical forest, an experiment that had never been tried. Was there any expedient by which the great forest might be avoided? The German Government was finally approached on the subject. Its permission was asked to extend the Cape to Cairo line through German East Africa into British East Africa where it could easily be carried northward. The reply of Germany was decisive. "It is not the policy of the German Government to permit railroads built by other European powers to enter German African territories."

England now holds the mandate for the former German East Africa. If she wishes to use that country as a link in the Cape to Cairo enterprise, she can do so; and if the railroad is thus completed the entire route will be in territory that is under the British flag or amenable to British law.

Geographic Names.—The Royal Geographical Society has formed a permanent committee on this subject, under the chairmanship of Major-General Lord Edward Gleichen. The committee is composed of representatives of the various government offices likely to be interested, and will deal with doubtful nomenclature and spelling for the British Empire, although the Ordnance Survey will continue to deal with the place names of the British Isles. The committee will base its work on name lists already in existence, such as the Gazetteer of India, and will publish lists of names from time to time as they are approved.

Some such work of this kind will be urgently needed for the Europe of the new nationalities. Old and well-known names are now appearing in strange forms indeed. For Prague we have Praha; for Pilsen, Plzen; for Budweis, Budejovice; for Lemberg, Lwow. Shall it be Danzig or Gdansk; Fiume or Rieka; Durazzo or Dures; Valona, Avlona or Vlore. In some cases even the names of the new states that have or may be created are not entirely clear—and this reminds one of the news received during the early days of the peace conference that it had been decided to decrease the size of the cabinet of the little state of Georgia, in the Caucasus region, "in order to reduce the costs of government"!

The French Coal shortage is still serious, though the Ruhr region of Germany will soon be delivering a steady supply. The Mining Society of Lens reports that it will take at least eighteen months to pump the water from the Lens collieries, and that work on the main seams certainly cannot be resumed before the end of 1920, and that it will take years to bring production back to the normal pre-war level. By the terms of the treaty of peace Germany is obligated to deliver to France 7,000,000 tons of coal per year for ten years, and in addition must make up the difference between the annual pre-war production of the coal mines destroyed by the Germans and their actual production during the years when they are being restored. This last amount, however, must not exceed 20,000,000 tons for any one year of the first five years, or 8,000,000 tons for any one year of the succeeding five years.

In consequence of the scarcity of coal there has been a great development of water power possibilities. A bill before the Chambre des Deputés provides for the erection of twenty power stations, with an average production of 715,000 horsepower, for the utilization of the water power of the Rhone. This would be equal to about one-eighth of the French coal output before the war, or 5,000,000 tons.

The plants would be erected by granting the concession to a company capitalized at $50,000,000 and privileged to issue bonds to ten times that amount. The bonds would be guaranteed by the state, which would have representation on the company's administrative council.

Transplanting the Cotton Trade?—Belgium hopes to make Ghent a great center for the distribution of cotton throughout central Europe. The sunken torpedo boats, fallen bridges and other debris reported to have been placed by the Germans on the day of the armistice in the waterway of the 18-mile canal which connects the city with the sea have now been cleared away, and the harbor is open for shipping. The canal can accommodate ships of 9,000 tons which draw 27 feet of water. Modern concrete warehouses have been built and many miles of railroad track are being laid.

The movement is backed by the Association of Belgian Spinners, which states that Ghent is nearer a greater number of spinning centers than Bremen, Havre, or Trieste, which will be her chief competitors. The distributors of Ghent are planning to use fast motor lorries where speed is required, and in this manner expect to compete successfully with Havre for the trade of Lille and the other great industrial centers of northeastern France.

The Belgian textile industry thus hopes to recoup itself for damage sustained during the war. These damages are estimated to total almost $425,000,000.

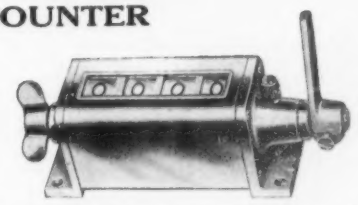
There is now a regular steamship service between Galveston and Ghent. The harbor was opened on March 15th last, and between that date and August 1st some 60,000 bales of American cotton had entered the port.

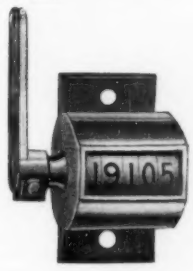
What's Due from the Job

Let the operator of your punch press see what his machine is *good* for, and what a good man should average. Keep right before him a running record of his *output*—registered open-to-view by a

Veeder COUNTER

The Set-Back Rotary Ratchet Counter at right is ¼ actual size. The small Revolution Counter below is illustrated full size.





The Set-Back Rotary Ratchet Counter above registers reciprocating movements of the lever, as required in counting the product of punch presses. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels as required. Price with four figures, as illustrated, $10.50.

The small Revolution Counter at left records the output of machines where a shaft-revolution indicates an operation. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines. Will subtract if run backward. Price, $2.00.

The new Veeder booklet is a complete exposition of counters for industrial purposes. Your own special needs are among those provided for. Let us send you a copy.

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BRUTE strength, scientifically applied, without bulk or clumsiness—that's Williams' "Vulcan" Drop-Forged Clamp.

All Williams' "C" Clamps are built with a purpose for every clamping purpose. Maximum capacity 18".

They are made for Heavy, Medium, Light and Toolmakers' Service by drop-forgers with nearly half a century's experience behind them. They are all guaranteed.

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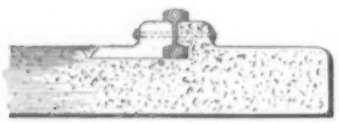
RECENTLY PATENTED INVENTIONS

(Continued from page 48)

Railways and Their Accessories

RAILROAD TIE AND RAIL CLAMP.—J. E. SPRINGER, 211 W. 50th St., Norfolk, Va. The invention relates generally to railroad ties, and more particularly to composite ties, the object being the provision of a manufactured tie to



SIDE ELEVATION OF THE TIE AS INVENTED

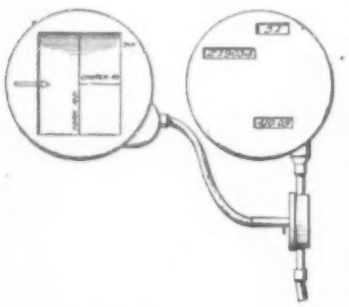
replace the usual wooden tie, having effective rail holding means which will not only avoid the use of spikes but will firmly hold the rails against spreading overturning and creeping and thus avoid the disadvantages of spike held rails, rail braces and the like, particularly at curves.

MECHANICAL AUTO INDICATOR SYSTEM TO ANNOUNCE ABNORMALITIES THAT MIGHT OCCUR IN ANY OF THE CARS WHICH FORM RAILWAY TRAINS IN MOVEMENT.—J. VALLARO, 1198 Calle Maldonado, Montevideo, Uruguay. This invention relates to railway appliances and to means providing signals on the different cars of a train as well as the engine when any car has been derailed or disconnected. Another object is to provide an arrangement for utilizing an electric circuit on the train which will be automatically closed when the car is removed accidentally or intentionally. The device may be applied to cars now in use without any appreciable change, and at small expense.

STREET CAR INDICATOR.—E. MYETTE, Manchester, Wash. The invention relates to street car indicators to be employed in informing the passengers as to the name of the approaching street and the like. An important object is to provide a device which is adjustable so that it will operate in opposite directions, and also may be set to operate from any selected street or point.

Pertaining to Vehicles

GUIDE METER.—W. H. HOLLIS, 235 Duval St., Germantown, Philadelphia, Pa. This invention relates more especially to guide meters which are used in connection with automobiles for touring purposes. An object is to provide a guide meter which indicates accurately every



A FACE VIEW OF THE DEVICE SHOWING ITS CONNECTION WITH SPEEDOMETER

town, curve, cross road, railroad crossing, hotel and garage en route; the device may be attached very quickly to any speedometer, and which is run by the flexible transmission member which runs the speedometer; the device may be disconnected from its power means to provide for side trips.

FOLDING SEAT.—A. CARLSON, Jacob Ave., S. Jamaica, L. I., N. Y. The object of the invention is to provide an auxiliary seat more especially designed for automobiles and other vehicles, arranged for convenient extension without interfering with the occupants of the rear seat. Another object is to permit of readily collapsing, folding and concealing the auxiliary seat in a storage chamber formed in the front seat.

LOCK FOR GEAR SHAFT LEVERS.—A. C. CURRAN, 55 Rodney St., Brooklyn, N. Y. The primary object of the invention is to provide means whereby the operating member of a motor vehicle transmission may be effectively locked against operation by unauthorized persons. A further object is to so construct the device that this applicable to the ordinary transmission shifting device at present in use with very slight changes in the construction thereof.

GREASE GUN.—H. O. and W. L. EKERN, Flandreau, S. Dak. The invention has for its object to provide a grease gun especially adapted for use as a portable garage gun, for forcibly ejecting heavy oil and greases, such as are used for lubricating the transmissions and differentials of motor vehicles. An indicator is provided which will indicate the amount of grease driven out of the gun.

ANTISLIPPING DEVICE FOR VEHICLE WHEELS.—C. F. STEPHENSON, 146 E. South St., Fostoria, Ohio. An object of the invention is to provide a device for vehicle wheels to prevent slipping especially when traveling over a soft roadway. Another object is to permit the attendant to conveniently and quickly place the device in position without requiring jacking up the vehicle. The device takes up very little room when not in use, and may be carried in a tool box or other receptacle on the vehicle.

ATTACHMENT FOR AUTOMOBILES.—M. C. WERTZLER, 1516 Ninth Ave., Seattle, Wash. This invention has for its object to provide an attachment to permit an automobile to run on snow, wherein runners are provided upon which the frame of the automobile is mounted, and wherein driving wheels are arranged at the rear of the frame and connected to the motor to cause the same to drive the driving wheels.

SELF STARTER.—J. ABLE, 408 Church St., Nashville, Tenn. The object of this invention is to provide a device of the character specified for use with motor vehicles, wherein a starter is provided, and a compression tank for receiving compression from the motor, the tank having a valved connection with the starter, to permit it to be connected therewith at will to operate the starter.

STEERING GEAR.—E. S. SCHEBLE, Cleburne, Texas. The general object of the invention is to provide a comparatively simple, inexpensive and effective steering mechanism which will positively prevent shocks being transmitted to the steering wheel when the car is traveling straight ahead, but which will permit of easy steering of the wheel. The steering device locks the steering wheels for straight ahead travel and automatically unlocks the wheels to permit them to turn.

GAS HEATER FOR AUTOMOBILES.—C. M. STUDEBAKER, Box 23, Centropolis, Kansas. The particular object of the invention is to provide an attachment for automobiles to assist in starting in cold weather; the device is a simple inexpensive arrangement which may be quickly applied, to the air intake pipe of the carbureter; and which may be utilized without inconvenience and will effectively operate for the intended purpose.

MOTOR VEHICLE.—D. C. GOFF, 2331 Washington Ave., Knoxville, Tenn. The invention has for its object to provide mechanism in connection with motor vehicle of the truck type for housing the driving mechanism which connects the wheel with the transmission in an oil and dust tight compartment, so designed as to remain oil-tight and dust-proof through an extended period of use.

SPRING WHEEL.—J. H. LANDRY, 406 Cutagamie St., Appleton, Wis. The object of the invention is to provide a wheel having the resiliency of a pneumatic tire, without danger of punctures or blow outs. A series of tread rings of rubber are provided to engage the ground, and to prevent shock or jar, a series of semi-elliptical springs having friction rollers and a series of coil springs between the tread and rim of the wheel.

Designs

DESIGN FOR A CLOCK DIAL.—L. E. MACOMBER, 331 Madison St., New York, N. Y.

DESIGN FOR A POST SERVICE BADGE.—ROSE M. BERRENT, 665 W. 160th St., New York, N. Y.

DESIGN FOR A LACE CURTAIN.—P. B. WORTHINGTON, 5223 Archer St., Philadelphia, Pa.

DESIGN FOR AN AUTOMOBILE.—C. T SILVER, 100 W. 57th St., New York, N. Y.

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Revival of Our Oldest Navy-Yard

(Continued from page 47)

mouth was the "Kearsage" which will ever be of great interest to Americans because of her famous encounter with the Confederate steamer "Alabama," which she sank off the port of Cherbourg, France. Limitations of space prevent a reference to many happenings at this yard which possess interest for the naval historian, but it should be recorded here that while on a visit to Commodore Pennock, Admiral Farragut died in the house which is still used as the residence of the Commandant. It was to this yard that the survivors of the Greeley Arctic Expedition were brought in 1884, and finally, it was at the Portsmouth Navy Yard, and in the then recently completed General Stores Building that the plenipotentiaries of Russia and Japan met, at the invitation of President Roosevelt, and signed the treaty which brought that war to a close.

It was about the year 1912 that the Navy Department began to move in the direction of designing and constructing its own submarines. The operating personnel of our submarines was becoming more experienced and was able to lay before the Department the features of design which they considered should be incorporated in these vessels, and during the latter part of 1915 and the early part of 1916 a considerable agitation was carried out by the Fleet to increase the size of our new submarines considerably, and to build vessels of about 800 tons' displacement, which had apparently been found to be the most satisfactory size of submarines in the English and German Navies. In this connection it may be noted that the submarines under construction at about that time were generally from 450 to 520 tons' surface displacement. As a consequence of this agitation and to obtain complete data upon the question, the Secretary of the Navy asked Congress to make an appropriation for three submarines of about 800 tons each, the idea being that one of these boats would be taken by the Navy Department to design and build complete itself. The contract for the other two would be awarded, one each, to the private builders of submarines. This appropriation was made in August, 1916, and shortly thereafter contracts for two of these boats were awarded, the S-2 to the Lake Company and the S-1 to the Electric Boat Company.

For the other vessel, the S-3, the Navy Department had been working on designs, with the expectation of the passage of the Naval Bill. While the designs were still in progress it was decided to build this first Government designed submarine, the S-3, at the Navy Yard, Portsmouth. This Navy Yard was decided upon, for one reason, because it was a Navy Yard under industrial management, which would facilitate the close coöperation necessary in the preparation of plans and the actual construction of a submarine, where everything must be worked in together with the least possible interference; and in the second place because at that time two submarines, the L-8, for which the plans had been purchased from the Lake Torpedo Boat Company, and O-1, for which the plans had been purchased from the Electric Boat Company, were under construction there, the building of these submarines having been undertaken with the idea of giving the yard practice on this class of work in the event that the Department should decide to build submarines largely in its own Navy Yards.

The designs of submarine S-3 were completed in January, 1917, and the order placed with the yard to go ahead at once with the work. To handle this work it became, of course, necessary to build up a drafting force, which at that time was particularly difficult, having in mind also the fact that skilled men were required.

Work on the ordering of materials and on the preparation of plans had hardly been well started on the S-3 at Portsmouth when in April, 1917, as a consequence of our entering into the war, and the increased appropriations for new ship construction, the construction of ten additional submarines of the same type as the S-3, to be called the S-4 to S-13, was assigned to this yard.

This, it will be understood, gave the yard, which had done practically no new ship construction since the days of wooden vessels, an extensive building program which necessitated the building up of a large force to be engaged in this work alone.

Our illustrations include a view, from the water, of the new covered shipbuilding ways, upon which four of the new 800-ton boats are being built. Of great interest is the old Franklin Shiphouse, 75 feet in height, where other submarines are being built. It is of timber and in an excellent state of preservation. From the roof timbers are still hanging the old hempen cables and the blocks with which the heavy timbers were hoisted into place. With what amazement must they regard the strange, modern, fish-like shapes that repose in the ways upon which only good, honest timber ships grew into shape, to the music of adze, saw and calking hammer!

Another picture of great interest shows the interior of a submarine pattern or full-size model. So great is the complexity of a submarine, especially as regards its piping and wiring, that no amount of draughtmanship, however careful, can determine the location of the thousand-and-one parts with respect to each other, with the exact precision that is necessary. Hence, the full-size model, in which every cylinder, pump, motor, pipe, cable, bulkhead, et cetera, is reproduced exactly as it will be in the steel vessel. In this way, clearances can be determined, pipe bends formed to exact shape, bulkheads marked for cutting, and, in short, exact templates and patterns secured for work in the shops. The saving in draughting and erecting labor is enormous.

As to the quality, both of the design and workmanship of the Portsmouth Yard submarines, we cannot do better than give the results of competitive trials between a Portsmouth-built boat and one of the latest German submarines, as announced by Acting Secretary of the Navy, Franklin D. Roosevelt.

The best of five German-surrendered submarines, recently brought to the United States, was tuned up for special trials. When reported ready, a special Trial Board was designated to conduct the trials, following the established practice in carrying out contract trials for submarines for the United States Navy. The boats compared were ex-German submarine U-111 built at the Germania Yard, Kiel, Germany (completed in 1918), and S-3, a submarine designed by the Navy Department; S-3 was built at the Portsmouth Navy Yard and was commissioned in 1918.

These boats both belong to the 800-ton class—U-111 having a surface displacement of 830 tons and S-3 a surface displacement of 854 tons.

DIMENSIONS.

	U-111	S-3
Length	235 feet	231 feet
Beam	21 feet	21.5 feet
Draft	12.5 feet	12.5 feet

In the trials the maximum surface speed of the U-111 was 13.8 knots, while the S-3 made 14.7 knots. The submerged speed of U-111 was 7.8 knots, while S-3 made 12.4—a remarkable difference in favor of S-3. The radius of action of the two boats is also in favor of S-3, despite all the furore that was created by the advent of the U-boats on the American coast during the war.

For U-111 can cruise 8,500 miles at 8

knots, while S-3 can cover 10,000 miles at 11 knots. The submerged cruising radius shows an equal preponderance in favor of S-3. Both boats can carry twelve torpedoes. U-111 mounts two 4-inch guns, one forward and one aft, while S-3 mounts one 4-inch forward, this practice of one gun on a submarine being standard practice in the United States Navy.

Much has been written of the seaworthiness of the German submarine. An opportunity to compare the seagoing capabilities of the two vessels occurred during these trials, and the general consensus of opinion among the officers conducting the test is that S-3 is the more seaworthy vessel. Her decks are drier, her bridge less subject to green seas, and her general behavior in a seaway superior. Referring to the comparative diving capabilities of the two vessels and general handling, there are few differences, and these few appear to favor the S-3.

New York State Barge Canal

(Continued from page 41)

by raising them from the sill by machinery or by hand. The largest Taintor gates in the world are located on the Champlain branch of the canal.

The bridge type of dam consists of a heavy steel structure very closely resembling a bridge in appearance. The spans vary from 150 to 240 feet between piers while a concrete sill extends across the bed of the river. Steel uprights are attached to the downstream chord of the bridge and when in position for use their lower ends rest against heavy castings set in the concrete sill. Steel gates are placed in tiers against the upstream side of adjacent uprights forming a dam. The water is maintained at the proper height above the dam by varying the number of gates used, in periods of low water all or nearly all of the openings are closed while as the stream rises above its normal level because of rains, the gates are removed from time to time to maintain the pool level at the proper height. In the event of a heavy flood and during the closed season on the canal all the gates as well as their supporting uprights are raised and attached to the bridge floor, leaving the flow of the stream unobstructed. The gates are raised or lowered by means of electrical winches running on the bridge floor of the dam. Only two automatic dams have been constructed on the canal.

Spillways

To reduce the fluctuation on certain levels of the canal, spillways have been built, so that as the water rises above the normal level it will pass over the spillway and into adjacent streams. At several locations a type of spillway known as the siphon spillway has been used. When the water rises above a certain point it begins to pass, at first slowly and then rapidly, through the siphons. This flow continues until the water has receded to a certain level when air enters the siphons and their action ceases.

By the use of this type of spillway it has been found possible to obtain the same regulation on a spillway 57 feet long as with one without siphons 200 feet in length.

Bridges

Several hundred new bridges have been built over the canals, the law providing that they should have an under clearance of at least 15½ feet when the water in the channel is at its maximum navigation stage. The greater number of these new bridges are of the fixed type; but a few towns and villages have been provided with vertical or bascule bridges. This was due to local conditions, and when closed the bridge forms a portion of the roadway, and when raised or opened gives the necessary clearance for the passage of barges.

Guard Gates

A type of structure which is very necessary as well as striking in appearance, is the guard gate. These have been placed at intervals of about 10 miles on all land lines, the intention being, that in the event of a break in the embankment or damage to a structure, that portion injured can be isolated by closing the nearest gates in each direction. This will tend to reduce the damage done to property by flood and will make it easier to repair any injury to an embankment or structure. Guard gates are also located at points where the land line joins the canalized rivers and lakes.

Terminals

In order that the Barge Canal may be of the greatest benefit it is necessary that harbors and terminals should be provided at various points where freight may be readily loaded or unloaded. It would be illogical to build a railroad across a country without making provision for passenger stations, freight yards and freight houses and it would, likewise, be illogical to construct a modern waterway without proper terminal facilities. Having this fact in mind the people of the State of New York, by popular vote provided funds for the construction of terminals along the Barge Canal. The plans for the terminals vary with the needs of the district served, but in general they consist of suitable docks, mechanical devices for the handling of freight quickly and cheaply, and buildings for the temporary storage of freight, while, in many cases, connections have been made with adjacent railroads.

The purpose of the state was to furnish places where any shipper can have the advantages of efficient terminal facilities at a reasonable cost. Funds have been provided for terminals at all the cities and many of the smaller towns and villages along the route of the Barge Canal. The majority of these have already been constructed while some equipment has been placed on many of them.

The mechanical equipment of the terminals and their general arrangement as to docks, buildings, railroad connections, etc., follow generally that in use in foreign countries in accordance with the report of a Barge Canal Terminal Commission which, in 1910, visited various European countries and reported on the types of terminal machinery used.

The Barge Canal is an extensive undertaking. It has been constructed at an expenditure, including terminals, of a little more than $150,000,000 and is now available. In constructing it every effort has been made to give the State of New York a thoroughly modern and up-to-date waterway connecting the Great Lakes with the Atlantic seaboard. Two years' operation of the completed system have demonstrated the truth that the waterway is a structural success. It is in a position, however, similar to that of a railroad system without locomotives or freight cars, and what is needed to make the Barge Canal a commercial and economic success is boats, boats and more boats, so thatit can carry its maximum capacity. This can be made as high as approximately 20,000,000 tons of freight per year.

(Continued in a later issue)

The Shunt-less Freight Terminal

(Continued from page 42)

does so well for the handling of letters.

By this system of Mr. Gattie's, all the itme lost in shifting a car of freight from one road to another is saved. The cars come right info the central terminal, to the tracks under the control of the road that is delivering them. But then the huge cranes would life the containers out of them, and in five minutes they would have been deposited in cars of the line over which they were to continue their journey. It must of course be borne

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in mind here that in England there are few box cars, the freight cars corresponding rather to our gondolas, though much smaller. It is this which makes the scheme outlined practicable. But while its adoption here might involve some change in equipment, such as the substitution of removable tops for the side doors now so universally in vogue in America, the general principle is none the less valid. Why shunt cars back and forth, and go through all the complications of sorting them over for making up into new trains in a huge classification yard, if the same end can be achieved more simply, more cheaply and more rapidly by means of containers and cranes?

Mr. Gattie, however, does not stop after eliminating the congestion of metropolitan terminals due to the handling of freight that is billed through them. He puts forward equally radical changes in the method of handling business that terminates or originates in the metropolitan district. To quote substantially from our London contemporary again, the trucker is the unit of the system here. By itself it looks like a railway flat-car of rather small size. On its flat top work two rollers set diagonally, and under this top is its machinery. A load is placed on a steel tray, which slides along an alley way until it comes to a sort of table with a flat top like that of a trucker, and having two rollers at right angles to those of the trucker. An endless belt of truckers runs on rails in a sunken pathway, much like the sunken trench in which the American subway runs between station platforms; and the passing string of trackers is on a level with the platforms, so that it looks like a moving footpath. When the tray with its load gets on the table, it waits until an unoccupied trucker passes it. Then the rollers on table and trucker begin to revolve, so that those on the table move the tray on to the trucker diagonally in the direction toward which the trucker is headed, while those on the trucker act with the first ones to draw the load on to the trucker, but act against the first ones in tending to move it in the direction opposite to the trucker's motion. The resultant of these two rolling motions is to shift the tray from the table to the moving trucker without any jar; and the rollers are magnetized during the process so that while the tray moves freely on them it cannot be lifted off them. A brimming glass of water can be thus transferred without spilling a drop. The trucker will carry the tray and its load along, and at a point fixed by pressing numbered buttons on a desk it will slip the tray off just as it was slipped on—or, if it does not go so far itself, it will transfer the load to the appropriate trucker. This kind of transfer is effected at points where two trains of truckers run together on parallel tracks for a distance, as shown at one point in our drawing, only to diverge and run to different destinations. In this way there are main trucker alleyways which communicate directly with the platforms on which the railroad cars are loaded and unloaded, and a vast number of subsidiary alleyways in which the truckers run to all parts of the establishment.

The goods, let us suppose, are put into railway wagons—or rather, into "containers" of standard size which fit into the railway wagons. The train arrives at the one great Goods Clearing House which replaces the seventy-four goods stations of London. It is hauled by an electric locomotive along one of the tubes which connect the Clearing House with all the railways to London. It stops on one of the lines running below the ground-floor of the Clearing House, lengthwise. A travelling electric crane is over each wagon, and lifts the container and its load off. Where is it to go? Perhaps the entire container-load is to travel to one place. It is let down an opening between the railway lines to a lower floor, the "crypt," where it is put on a belt of large truckers and automatically sent to a particular point of that floor. Here it may wait a short time or may be hoisted up to the railway level and deposited in a truck of another waiting train. Or, if the whole load is to go by road, it is hoisted one floor higher to one of the roads that run across the building at right angles to the railway lines. There the right lorry is waiting for it. Or again, the container may be filled with packages for various destinations.

Then it goes up to a sorting floor above—there are two for large packages and two for small, each with its smaller and slower belts of truckers going round sections of the floor, and the big faster belt travelling round the whole floor—and an escalator belt linking the two floors. A container comes up with goods from Glasgow; one package in it is for Southampton. An operator in the Glasgow section takes the package out by hand, or by an electric crane, and puts it on a steel tray. When this reaches the despatching point, he presses buttons giving the number of the Southampton section. No hand touches the load till the faithful truckers slide it off in the Southampton section.

The Built-Up Angle Gage

(Continued from page 46)

tained this state of affairs, the angle between the two blocks is exactly the sum of the two angles marked on them separately.

If we wish to construct an angle greater than 90 degrees, we can always achieve this result by setting up its supplement and subtracting this from the straight angle. Accordingly it is not actually necessary to supply on our gages any angles greater than 45 degrees; but as will be seen, the angles from 45 degrees up to about 60 are supplied as a matter of convenience. Then there have to be blocks giving the minutes, from one to 59; and with four angles on a block, this would use up altogether but 30 blocks. The great number to which the set runs is due to the fact that we can never use three blocks to build up an angle, but must always get our desired opening between two blocks. It is accordingly necessary to have a comparatively large number of blocks giving combinations of degrees, minutes and seconds, in order that we may never be confronted by a situation in which we can build up an angle of, say, 47° 15′, and one of 48° 20′, but are baffled by one of 48° 15′. The manufacturers of the set assure us that this sort of impassé cannot happen—that they have provided, in the 340 corners which the set contains, enough of the cruel and unusual combinations to cover any demand which may be made. And they have also provided a little clamp by means of which, after we have fitted two of the blocks together to form a particular angle, we can hold them together while we use this angle.

A Rotary Table for the Sand Blast

(Continued from page 46)

has also a ten-inch opening to be used for the passage of the work to and from the blasting zone, it is available for pieces of considerable size and weight. During the operation of the blast this opening is closed by multiple, sectional, flexible rubber curtains, which retain the flying abrasive and dust, making the machine a hygienic one and available for installation in the room with other machine tools without any detriment to the latter.

In our left-hand drawing is shown the oscillating nozzle, a part of the table, and the adjusting mechanism. In the center we have the top of the machine, showing the dust-tight compartment and the driving mechanism; while at the right the assembled outfit is viewed from the outside.

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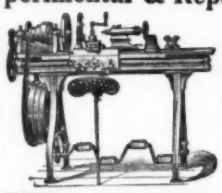

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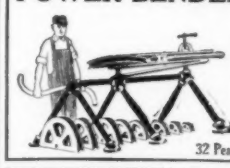

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Westinghouse

LINE AND POWER PLANT EQUIPMENT

The Transformer

Search where you will in the pages of electrical history, you will find few, if any, developments more significant than that of the transformer.

No choice of name for it could have been happier, for the transformations it has wrought have been astonishing.

It transformed an age of steam into an age of electricity. It transformed wilderness into populous communities. It transformed the town, with its slow-moving horse cars, its feeble oil or gas lamps, into the hustling twentieth-century city. It has transformed commerce and industry, office and home, carrying into each the electrical economies that characterize the life of today.

For it is the transformer's ability to change the intensity of current that has made possible transmitting electricity over long distances economically, then "stepping down" this current so that it may be applied with safety to the task of driving a motor in a street car or industrial plant, lighting your lamps or cooking your dinner in an electric range.

For the transformer as it exists today the world owes much to George Westinghouse and his associates. He brought the idea, then crude and imperfect, to this country from England in 1885. Through his foresight and ingenuity, a system of electrical distribution based on the transformer was developed.

In 1892, at Pomona, California, Westinghouse built the first line to transmit power at the previously unheard of pressure of 10,000 volts. Today 150,000-volt transformers are in common use and Westinghouse has produced others with capacity as great as 220,000 volts.

It is not alone in size, however, that the transformer has progressed. Largely by improving insulation through the use of oils, for example, Westinghouse has reduced to a small figure the amount of current which is lost as heat, effecting big economies in transmission.

Whether it be a big power plant transformer such as is shown on these pages or a much smaller one on a pole outside your home, remember the next time you see it that it is performing a task of immeasurable benefit to you and to all mankind.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
East Pittsburgh, Pa.

Picked By the Government Chosen By Big Business

GMC ¾ to 1 Ton Truck Through Reliability and Endurance in War and Every Day Commercial Use Wins First Place as High Grade All-Purpose Truck

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So well did this truck perform that it attracted the attention of the United States Government.

When trouble broke out on the Mexican border it was put into strenuous ambulance service. When the United States joined the Allies in the World War the GMC ¾ Ton Model was put into active service both here and overseas with high credit.

When the War Department sought to classify the various motor trucks according to a fixed number of standard models this GMC ¾ ton truck was picked as it stood for class AA in place of a design developed by Government engineers.

Again the GMC ¾ Ton Model had measured up to the need—it had done more, for its great margin of safety justified Government engineers in adopting it for both the ¾ ton and 1 ton classification.

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